the NATURAL GAS ...T. G. T. 10 YEARS LATER

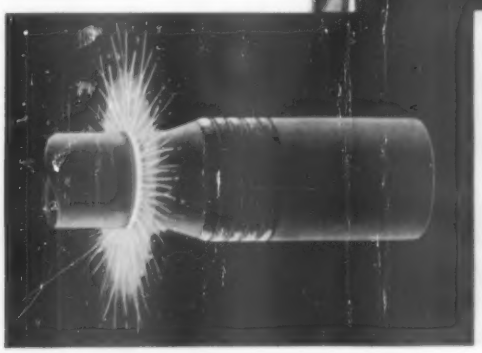
OIL AND GAS JOURNAL

Profit from this experience

Hughes *Flash-Weld* tool joints are veterans of the oil patch! Since 1938, more than one million HUGHES *Flash-Weld* tool joints have been used in unitizing over 32,000,000 feet of drill pipe.

The performance records of these joints in thousands of wells prove they make the most dependable drill stem you can run in your well. And that they cost you less per foot of hole drilled!

When you specify HUGHES you get the *original Flash-Weld* tool joint... and the drilling industry's greatest flash-welding experience.



FLASH-WELD
A DEVELOPMENT
OF
HUGHES
TOOL COMPANY
HOUSTON, TEXAS

PRICE 50 CENTS TABLE OF CONTENTS ON PAGE 1 MAY 10, 1954

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...have proved their efficiency

North, east, south and west . . . Hortonspheroids® have *proved* their efficiency to reduce evaporation loss of volatile liquids throughout the country. The 100,000-bbl. Noded Hortonspheroids above are in natural gasoline service at Warren Petroleum's Company's Northworthy Terminal, Houston, Texas. 141-ft. 6-in. in diam., these Hortonspheroids were designed for a working pressure of 15 lbs. per sq. in.

Hortonspheroids are built in standard capacities to 120,000-bbls. and in the smaller capacities for pressures up to 100 lbs. per sq. in. When planning storage facilities for volatile hydrocarbons be sure to write our nearest office. Chicago Bridge & Iron Company engineers will be happy to recommend installations best suited to your operation . . . at no obligation to you.

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the OIL AND GAS JOURNAL

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In Brief . . .

"The natural-gas industry in the next 10 years will continue the expanding trend which in the past 10 years has brought it wide recognition as possibly the fastest-growing industry in the nation. It is not anywhere near the peak."

This is the prediction of Gardiner Symonds, president of Tennessee Gas Transmission Co., in his article introducing the special T.G.T. section.

Gardiner bases his predictions on T.G.T. expansion which in the last 10 years has increased system capacity more than seven times and compressor horsepower more than eight times. Other T.G.T. articles following that of Symonds take up in detail the improvements and growth that may be expected in the next 10 years.

Hartzell Cooling Tower Fans Handcuff These Thugs

Corrosion, abrasion and vibration can't get the best of a fan with Hartzite plastic blades. That's why these thugs steer clear of a cooling tower or heat exchanger equipped with Hartzell fans.

Hartzite blades absorb vibration, resist abrasion and are unaffected by most industrial acids, mild alkalics and weather. Even when the surface of the blade is damaged, you're not in trouble—the interior has the same high resistance to corrosion and mechanical damage.

Nearly every Hartzell fan installed since the introduction of the Hartzite plastic blade in 1941 is still in service today. Where one Hartzell has been installed on a battery of cooling towers or heat exchangers, "Hartzell" is invariably specified as additional fans need replacement.

For more details on how Hartzell, "the" cooling tower and heat exchanger fan of the petroleum industry, can handcuff the cooling tower thugs who have been causing you trouble, write today for your free copy of Bulletin A-111.

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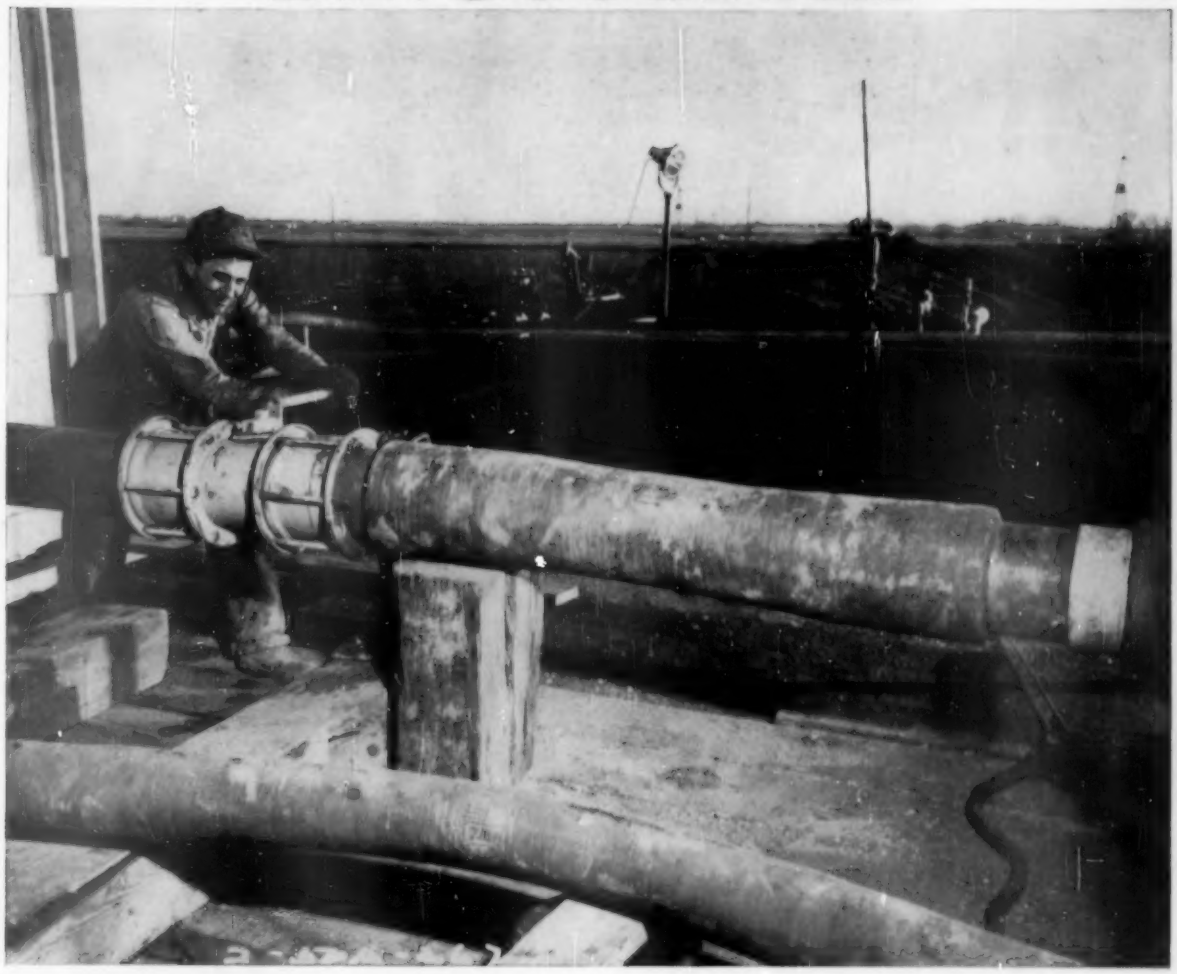
ROOF VENTILATORS • UNIT HEATERS

ENGINEERING OFFICES IN PRINCIPAL CITIES

RESEARCH KEEPS **B.F.Goodrich** FIRST IN RUBBER



Mud pump hose tough all over; tube would outwear steel

COVER, tube, reinforcements—all have been improved by B. F. Goodrich to build a mud pump suction hose to take more rough wear than any hose you've ever used.

Smooth, tough tube—B. F. Goodrich mud pump suction hose has an oil-proof tube especially developed by B. F. Goodrich to give high abrasion resistance. It's so tough it actually outwears steel in many applications. Tube is smooth so mud flows through at high speed.

Roughneck cover—It's practically abrasion-proof. Move it from job to job, drag it into position, load it into a truck—but be sure it's B. F. Goodrich hose with its extra-tough cover for extra-hard service.

Takes your highest vacuum—B. F. Goodrich mud pump hose will take the highest vacuum pressures used in mud pump work. Heavy spring steel wire spiral-wrapped and imbedded in rubber prevents collapse, keeps rig drilling without costly repairs.

Cords cushioned in rubber—This hose is reinforced with four to six plies of cord—held together and cushioned by rubber that surrounds each individual cord. No cross threads. Hose is more flexible to help dampen vibration, yet stronger to resist crushing and kinking.

Should your local supplier be temporarily out of stock when you call, you can get B.F.Goodrich mud pump hose any time—day or night—from one of these B. F. Goodrich warehouses: Beaumont, Dallas, Fort Worth, Hobbs, Houston, Odessa, Wichita Falls, Great Bend, Oklahoma City, New Orleans, Tulsa, Williston, Denver and Los Angeles. *The B. F. Goodrich Company, Dept. M-238, Akron 18, Ohio.*

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INDUSTRIAL PRODUCTS DIVISION

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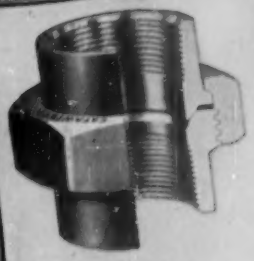
for greater operating efficiency and economy in every oil-field service

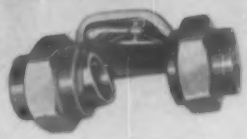


CATAWISSA NO. S-1A

The hot-forged steel union with heavy, coarse ACME threads in the union nut for quick make-up or disconnecting in the field.

CATAWISSA NO. S-1

Hot-forged steel unions with U. S. Standard V-Threads in the union nut are recommended for general oil-field service.

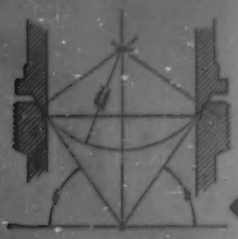


CATAWISSA NO. 302 CHECK VALVE

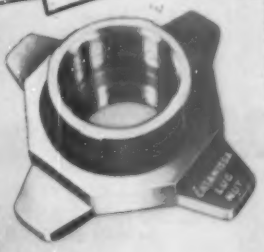
Accessible, efficient, economical, Catawissa Double Union Swing Check Valves are full opening and are furnished with union connections on both ends, eliminating the union and nipple necessary to install the regular type check valve. They are the flow-line type designed for use where no stop is installed close to the check valve.

CATAWISSA NO. L-1A

This union is furnished with a 2-lug nut which can be applied with either a hammer or wrench. The triangular shape eliminates distortion or breaking. Designed with coarse ACME threads for general service on drilling rigs and all piping purposes where quick make-up is desirable. Available in standard and double extra heavy weight. Sizes 1" to 3" inclusive.



BALL-TO-ANGLE SEAT



CATAWISSA NO. L-1-4A

Made in 4-inch size with four lugs on the nut.

"OILWELL" store and warehouse points are stocked with a complete line of Catawissa forged-steel unions and check valves. These Catawissa products are designed and recommended for the rough-and-ready demands of any oil country application.

NOTE THESE IMPORTANT FEATURES

HOT-FORGED . . . from solid, rectangular steel bars, Catawissa Unions are free from sand and blow holes. They will expand and contract with the pipe, assuring tight joints.

THREADS . . . Catawissa Unions and Valves are supplied with either FULL ACME Threads or U. S. Standard V-Threads in the union nuts and on the female end.

SEATS . . . in all Catawissa Unions are a 55° angle on the female end to a Ball on the male end, assuring a perfect seal even when the pipe is not perfectly aligned. Carefully hand-ground seats which require no packing are inspected and tested under water to assure holding qualities.

Contact your nearest "Oilwell" representative to assist you with all your oil-field problems

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TRADE MARK

UNITED STATES STEEL

A CONTAMINATION-FREE PRODUCT *with* OPW

LINE STRAINERS

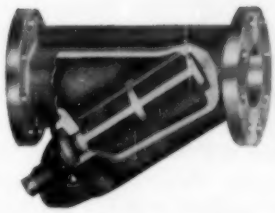
187

Bottom Outlet Type

Is your product absolutely clean, your pump and loading valve protected against scale, grit, dirt and other foreign materials?

Be sure! Use OPW Line Strainers for a contamination free product. Tight fit of cage and screen assures all product passing through strainer. Screen areas are many times pipe size for full flow. The simplicity of screen removal, cleaning and replacing, facilitates regular, periodic checkup in the shortest possible time.

Choose your size, type and mesh! 125-pound standard or 200-pound high pressure types. Bottom or top outlet cage, reinforced for sturdiness and precision-fit. Screwed or flanged end. Flanges, bolts and gaskets to suit. Strainer meshes from 14 to 300.



No. 187-F

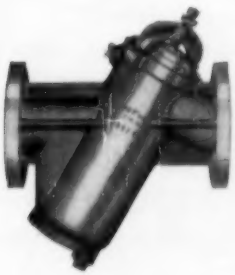
Bottom opening type. Heavy cast iron body, 125 pound. Furnished with 40 mesh bronze cage, reinforced screen for gasoline, 14 mesh brass screen for fuel oil.

No. 387

Top outlet type. 125 pound. Heavy ribbed iron body has tapped plug in top section for air relief connection, also bottom drain plug. Both drilled for seal wires.

No. 487-F

Top outlet type 200 pound flanged, drilled and faced on pipe ends with bolted, gasketed cap.



No. 387-F

Top outlet type cage, perfect for pit application. 125 pound flanged, drilled and faced. Cap can be seal wired to prevent tampering.

OPW CORPORATION

2731 COLERAIN AVE. CINCINNATI 25, OHIO

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$10,000 GUARANTEE ON USED EQUIPMENT!

Never before a guarantee like this! Only your CATERPILLAR DEALER offers a "BONDED BUY" on used Caterpillar-built equipment backed by a bond of $10,000.

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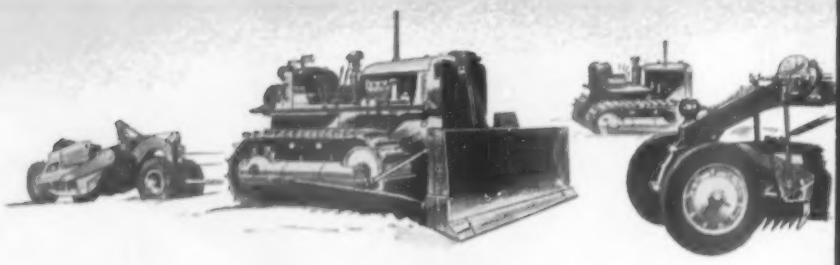

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You KNOW what you're getting at your CATERPILLAR DEALER

Your Caterpillar Dealer offers you three clear-cut classes of used equipment. He backs each one in writing. You buy with confidence, sure that the equipment is honestly described. See him for the best values on the market!

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Hydro-Spring Tester — Patent Applied For

HALLIBURTON'S *REVOLUTIONARY*

HYDRO-SPRING TESTER

So simple to operate a "weevil" could run it. In the skilled hands of a Halliburton operator the Hydro-Spring Tester gives a perfect performance practically every time.

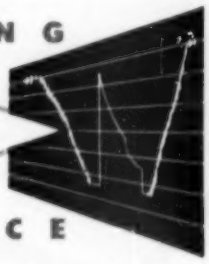
All you do is set down weight on the packer and then wait a few minutes for the tool to open. A noticeable movement on the weight indicator tells you when tool is open. Tester valve opens and closes rapidly, decreasing the time for any fluid cutting that would be caused by "half-open" valves.

If a bridge is encountered going in hole you can set down weight up to 200,000 pounds – even spud if desired – just so long as weight is removed every minute or so. Hydro-Spring Tester does not open until at the end of the maximum time delay.

The locked open by-pass operates positively in relation to the tester valve. When Hydro-Spring is closed the by-pass is open; and when the tester is opened the by-pass is closed. Operation is such that the by-pass closes an instant before the tester valve opens.

What could be simpler? No wonder Hydro-Spring makes history for the smoothest test ever run. Have you made the swing to Hydro-Spring? It'll save you time, trouble, money. Try it next – just phone your local or district Halliburton office. Or contact Halliburton Oil Well Cementing Company, Duncan, Oklahoma.

TESTING
HALLIBURTON
SERVICE



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TRANSFORMERS
...the choice of leaders in industry

CHOOSE WAGNER UNIT SUBSTATION TRANSFORMERS

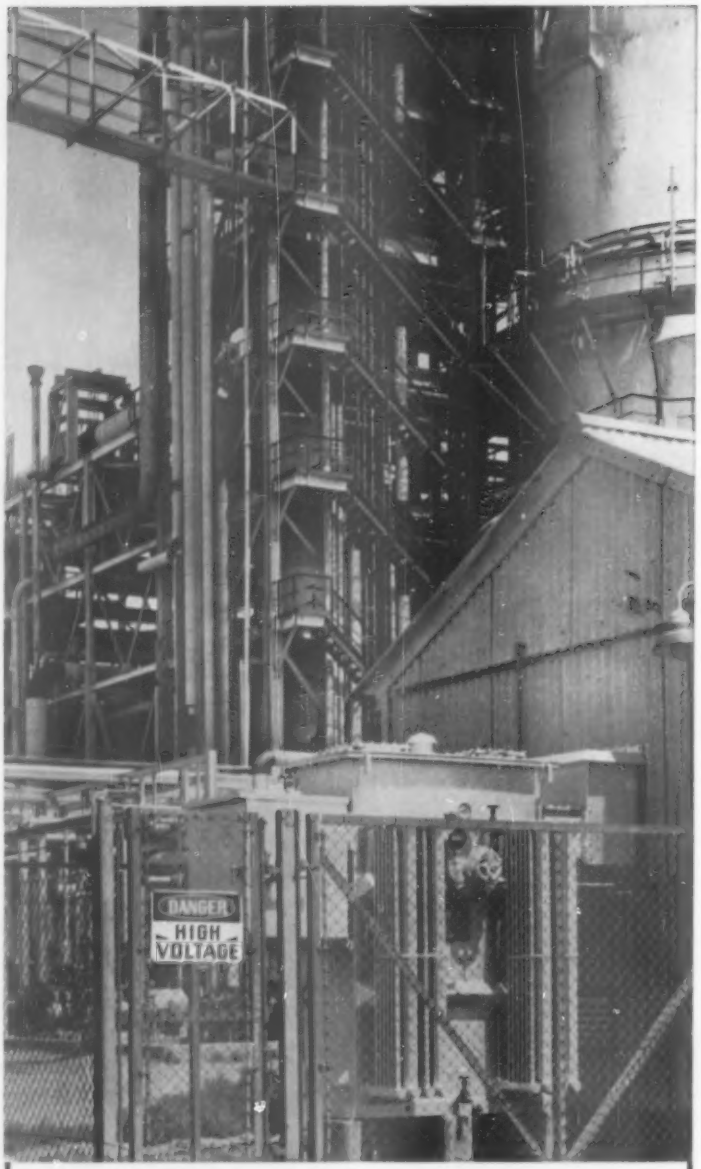
for always dependable power...

Here's dependability at work! This Wagner liquid-filled unit Substation Transformer feeds the catalytic unit at The Carter Oil Company refinery in Billings, Montana.

You'll find hundreds of Wagner Transformers, furnishing *always dependable* power, in spots where failure would incur great cost, because Wagner Transformers are known for their unfailing dependability—a reputation backed by more than sixty years of transformer building experience.

Wagner Unit Substation Transformers, both liquid-filled and dry-type, are carefully designed to meet distribution requirements. Both liquid-filled and dry-type unit substation transformers are built in ratings through 2000 kva, 15 kv and below—you can choose the type and rating that exactly meets your load-center distribution requirements.

Bulletins TU-13 and TU-56 give full information. Your nearby Wagner engineer can help you solve your load-center problems. Call the nearest of our 32 branch offices, or write us.



This 750 kva, 2400/4160Y to 480 volt, 60 cycle, three-phase, liquid-filled Wagner Unit Substation Transformer feeds the catalytic unit at The Carter Oil Company, Billings, Montana refinery. It is throat connected to switchgear in the adjoining building. Purchased and installed by The Fluor Corporation, Ltd., Engineers and Constructors for the Petroleum, Chemical and Power Industries, Los Angeles.

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EST. 1891

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INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS—AIR AND HYDRAULIC

T54-3

WE ACCEPT THIS OBLIGATION

If you make or use flash-weld tool joints, you have every right to expect A.P.I. seamless drill pipe to measure up.

For J&L we accept this obligation to manufacturers and drillers – and pledge you certain lagniappe.

The A.P.I. monogram on drill pipe is a very reassuring emblem, but the requirements of the American Petroleum Institute can go only so far.

You can't prescribe 100 years of experience in making steel, or continuous control from mine to finishing process. These things you get, at no extra cost, in J&L A.P.I. Seamless Drill Pipe, grades D and E, external and internal upset.

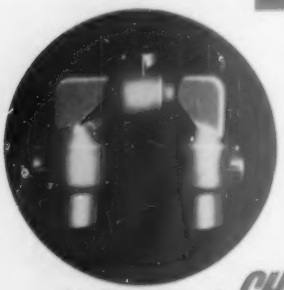
J&L STEEL

Jones & Laughlin
STEEL CORPORATION
SUPPLY DIVISION —— TULSA
Serving The United States and Canada

Above unretouched photograph shows the "guts" of the original 2" style 50 single ball race CHIKSAN Swivel Joint after 20 years of rigorous service in the California oil fields. Note the good condition of the wearing surfaces. This joint has been improved through the years to the present modern double ball race joint.

The CHIKSAN Ball Bearing Swivel Joint illustrated above is an unretouched photograph of a veteran of 20 years service on an oil well cementing hose.

CHIKSAN IS NO "JOHNNY COME LATELY" TO INDUSTRY...



Modern types of **CHIKSAN** *swivel joints.*

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- Originator and largest exclusive manufacturer of ball-bearing swivel joints.
- The widest range of styles, sizes and pressures available for every major industry.
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- World-wide recognition for highest quality and lowest maintenance costs.
- Complete nation-wide coverage by qualified field service engineers.
- If you require unlimited flexibility with unlimited life—be sure you *specify* and *buy* CHIKSAN Ball Bearing Swivel Joints.

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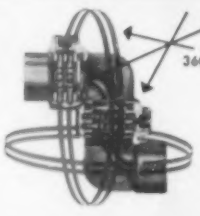
Ball-Bearing Swivel Joints

THE NEW TOOL OF MODERN INDUSTRY



CHIKSAN Ball Bearing Swivel Joints are THE NEW TOOL of Modern Industry with full 360° rotation in 1, 2, and 3 planes. Over 1,000 different types, styles, and sizes have been developed for pressures and services from 28" vacuum to 15,000 psi and for temperature ranges from minus 70° to a plus 500° F. with packing materials for each specific service.

CHIKSAN COMPANY • BREA, CALIFORNIA • Chicago 3, Illinois • Newark 2, New Jersey

Well Equipment Mfg. Corp. (Division), Houston 1, Texas • Subsidiaries: Chiksan Export Co., Brea, Calif., Newark 2, N.J. • Chiksan of Canada Ltd., Edmonton, Alta.

NEW

12 SVG

660 HORSEPOWER

BEAIRD-INGERSOLL-RAND

PACKAGED COMPRESSOR PLANT

The J. B. Beaird Company, Inc., pioneer developer of the Packaged Compressor Plant, announces the 660 horsepower 12SVG. With the addition of this model, Beaird makes available to oil and gas producers a complete line of Packaged Compressor Plants from 110 horsepower to 660 horsepower.

BEAIRD

COMPLETELY PACKAGED

FULLY ASSEMBLED

The 12 SVG packaged compressor plant is a complete plant, including every part, connection and control required for unattended field operation. The entire plant is assembled at the factory, ready for installation in the field.

HERE'S WHAT IS CONTAINED IN THE PACKAGED PLANT:

Ingersoll-Rand gas engine driven compressor.

Young Radiator with complete cooling system for gas, oil and water.

Gas piping, manifolds, scrubbers and dump traps, properly designed and sized by process engineers.

Jacket water surge tank, piping and automatic controls.

Fuel gas system with surge tank, regulator and all necessary piping.

Starting air system with compressor, storage tank and air piping.

Complete lubrication system with heavy duty filter and all oil piping.

Controls which shut down compressor automatically in the event any unusual operating conditions should develop.

Sturdy steel base, fabricated from structural steel members, which requires only a simple concrete slab foundation.

BEAIRD

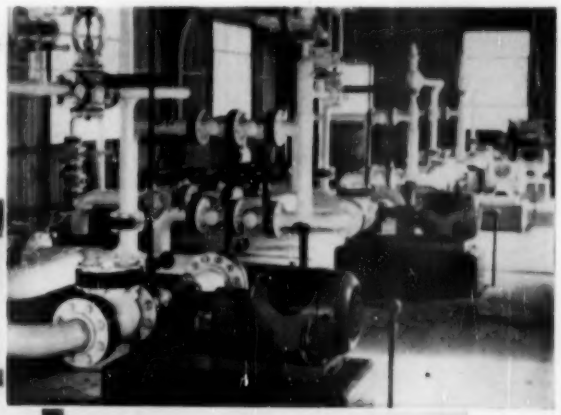
If you require a compressor station of hundreds or thousands of horsepower, let us make you a proposal on using Beaird-Ingersoll-Rand Packaged Compressor Plants. Give us your operating conditions so that we can show you with actual figures, how you will save money on both installation and operation.

THE J. B. BEAIRD COMPANY, INC. SHREVEPORT, LOUISIANA

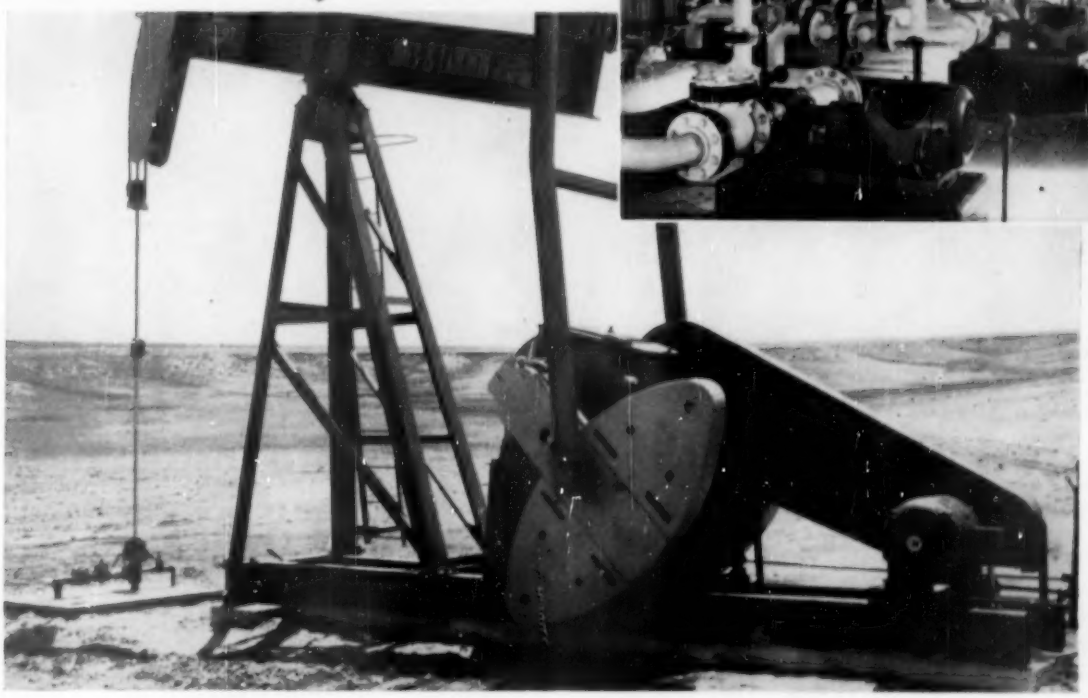
Century Motors are Performance Rated® to fit the job!

THE TOUGHER THE PUMPING THE BETTER THEY LIKE IT

EXPLOSION PROOF 7½ H.P. Century Performance Rated Explosion Proof Motors drive loading pumps in oil field processing plant



SPLASH-GARD 20 H. P. Century Performance Rated Oil Field Motor powers a pumping unit.



- It's easy to match the motor and the job when you make your selection from the broad and varied Performance Rated Century line.
- By picking the Century Motor that's *right* for the job, you bring out all the performance built into the equipment you use . . . you're sure of dependable operation under all kinds of conditions.
- **FOR OIL PRODUCTION,** Century Performance Rated Oil Field Motors are widely used in outdoor pumping applications. Type SCT high torque, high slip motors start stiff pumps easily . . . minimize shock reaction to parts.
- **FOR REFINING AND DISTRIBUTION,** Century Performance Rated Explosion Proof Motors protect life and property in explosive atmospheres.

Check your supply store or Century Branch Office. Investigate the complete range of Performance Rated Century Motors—in sizes from ⅙ to 400 H.P.

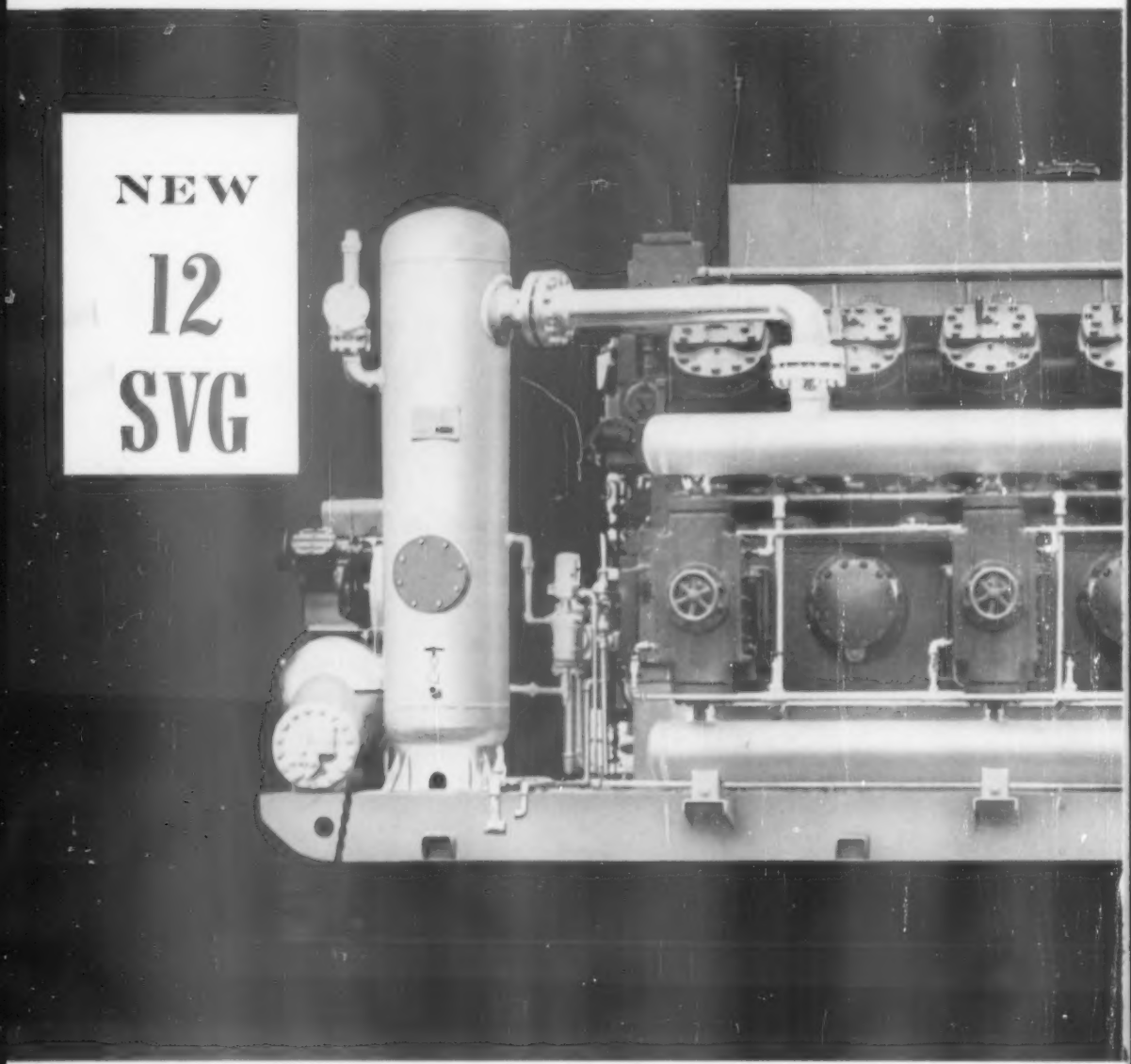
CENTURY ELECTRIC COMPANY

1806 Pine Street, St. Louis 3, Missouri

Offices and Stock Points in Principal Cities

Century C MOTORS

A COMPLETE 660 HORSE

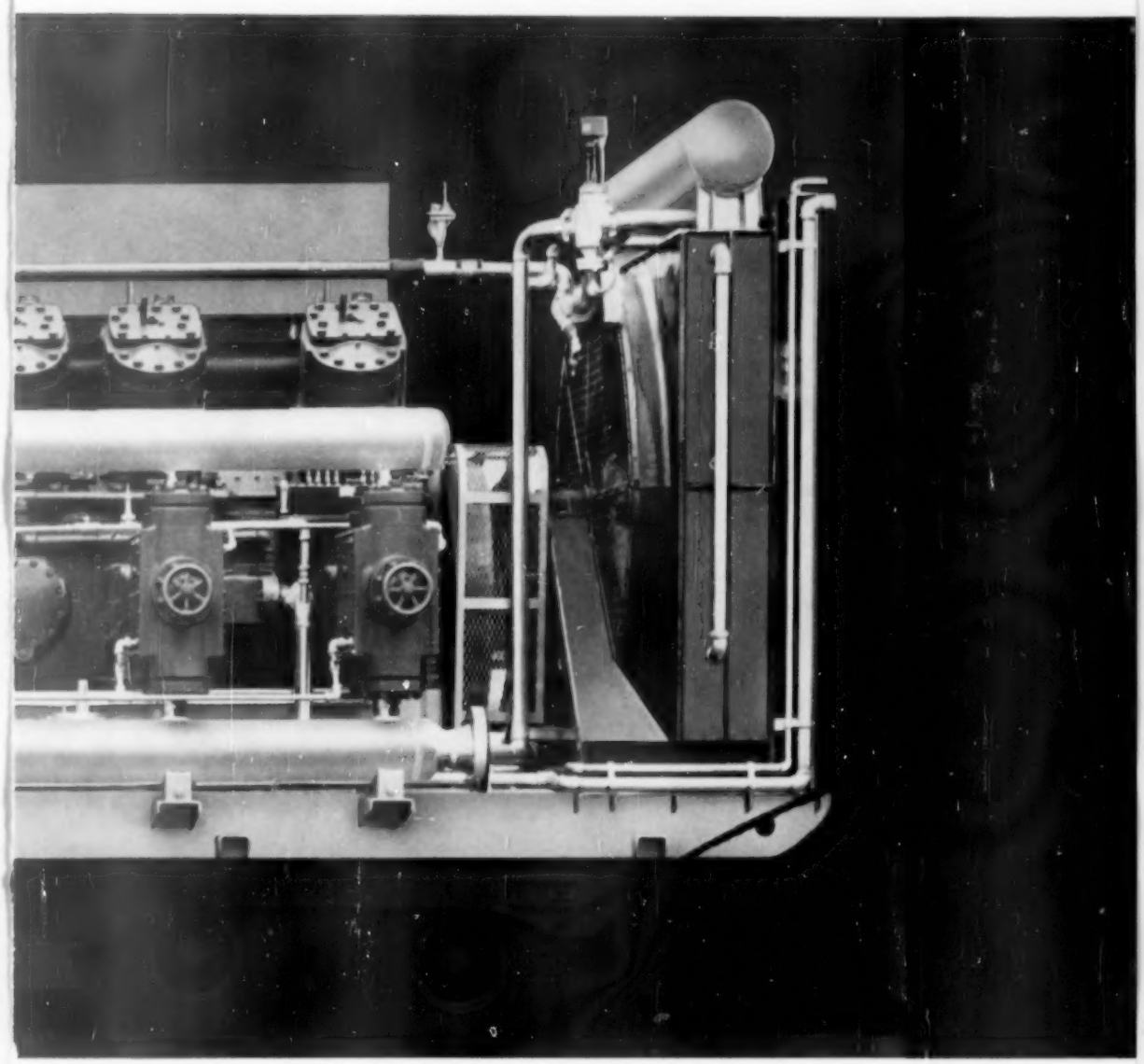


Now you can install a compressor station — even one running into thousands of horsepower — in just a few days. And the cost per horsepower, installed, is lower than ever before. For the new 12SVG surpasses even the 10SVG in low cost and low weight per horsepower. Like other Beaird-Ingersoll-Rand Packaged Compressor Plants, the new 12SVG is complete in every way and yet it can be transported as a unit on a heavy oilfield trailer.

BEAIRD-INGERSOLL-RAND
Packaged Compressor Plant

POWER COMPRESSOR PLANT

All in One Package



SPECIFICATIONS

Horsepower Rating	**660**	*Compressor Cylinder Stroke*	**12″**
Engine RPM	**400**	*Over-All Width*	**11′-0″**
Power Cylinder Bore	**11¾″**	*Over-All Length*	**28′-0″**
Power Cylinder Stroke	**12¾″**	*Over-All Height*	**12′-1″**
Maximum Number Compressor Cylinders	**4**	*Approximate Weight*	**86,000 lbs.**

BEAIRD

THE J. B. BEAIRD COMPANY, INC.
SHREVEPORT, LOUISIANA

NEW

12 SVG

660 HORSEPOWER

BEAIRD-INGERSOLL-RAND
PACKAGED COMPRESSOR PLANT

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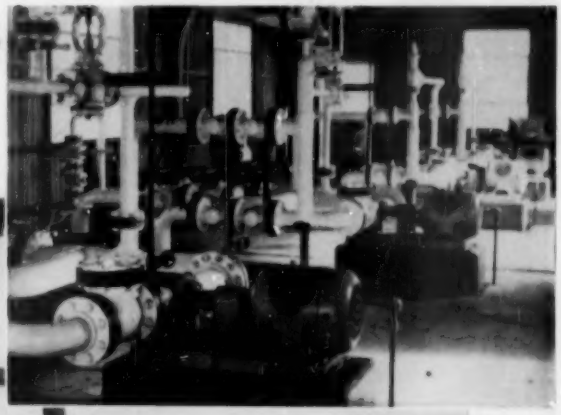

SPLASH-GARD 20 H. P. Century Performance Rated Oil Field Motor powers a pumping unit.

- It's easy to match the motor and the job when you make your selection from the broad and varied Performance Rated Century line.
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- **FOR REFINING AND DISTRIBUTION,** Century Performance Rated Explosion Proof Motors protect life and property in explosive atmospheres.

Check your supply store or Century Branch Office. Investigate the complete range of Performance Rated Century Motors—in sizes from ⅙ to 400 H.P.

CENTURY ELECTRIC COMPANY

1806 Pine Street, St. Louis 3, Missouri

Offices and Stock Points in Principal Cities

Century C MOTORS

833

When your communications are installed, Bell System service has just begun!

Installation of communication equipment is just the beginning of your Bell System service.

Behind every piece of equipment stands an army of trained technicians. Their skills are the end product of Bell System's 78 years of communications experience.

The work of these specialists is one reason for our remarkable record of reliability in the pipeline field. From research through manufacturing, installation, operation and maintenance, Bell System people are on the job continually. They make sure that you get the finest communications service in the world.

Whether you need private-line telephone, mobile telephone or teletypewriter service, or channels for remote metering and supervisory control, get Bell System experts on *your* team.

• • •

Your Bell Telephone Company will be glad to study your communications problems and needs without charge.

PRIVATE-LINE TELEPHONE

TELETYPEWRITER

MOBILE TELEPHONE

METERING CHANNELS

BELL TELEPHONE SYSTEM

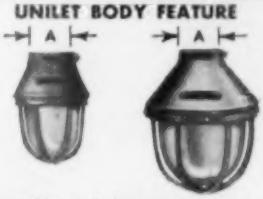
Relamp or Convert to Higher Wattages in **SECONDS...**

with

APPLETON

vented Explosion-Proof Fixtures

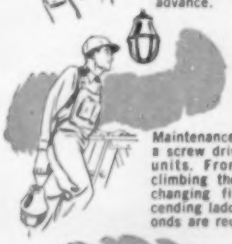
APPLETON INTERCHANGEABLE UNILET BODY FEATURE



Note how identical diameters "A" at top of Dome Unit Assembly permit mounting of all fixtures regardless of wattage.

58 SECOND RELAMPING

When the call comes for relamping, AA-51 Series STAND-BY Units are ready at an instant's notice. Carrying handles can be attached in advance.



Maintenance man needs only a screw driver to exchange units. From the time of climbing the ladder to exchanging fixture and descending ladder, only 58 seconds are required.

Burned out lamps and cleaning fixture are safely attended to at the work bench, while production schedules are maintained.

Standardized Unilet Body Permits 58 Second Interchange of 60 Watt to 500 Watt Fixtures . . . Saves Time, Prevents Shutdowns! *Appleton* AA-51 Series Vented Explosion-Proof Fixtures offer the most complete protection available today against spark-caused disaster . . . plus the shortest possible lamp exchange time regardless of individual lamp wattage, with no loss of man-hours and no lengthy machinery shutdowns.

The AA-51 Series meets all Underwriters' Laboratories requirements for Class I, Groups *C* and *D* Hazardous Locations.

More and more plants in the petroleum industry are standardizing on *Appleton* for maximum, efficient protection in hazardous areas. Full details are available. Write Today for Bulletin!

- **"FLAME-TIGHT" CONTACT CHAMBER**
  Because of *Appleton's* exclusive "5-Thread Safety Chamber" any AA-51 Series Unit can be serviced with complete safety even if current is inadvertently left on!
- **"FULL-CIRCLE" VENTING**
  The notched globe ring and the porous metal interior dissipate heat evenly and safely and keep fixture temperature cool enough to prevent igniting explosive gases.
- **"STAND-BY" SYSTEM SAVES MONEY**
  For every ten AA-51 Units in operation *Appleton* recommends one unit as a stand-by . . . ready for relamping or wattage conversion in 58 seconds.

SOLD THROUGH ELECTRICAL WHOLESALERS

APPLETON ELECTRIC COMPANY
1718 Wellington Avenue • Chicago 13, Illinois

Also Manufacturers of:

Malleable Iron Unilet Fittings

Industrial Lights

"ST" Series Connectors

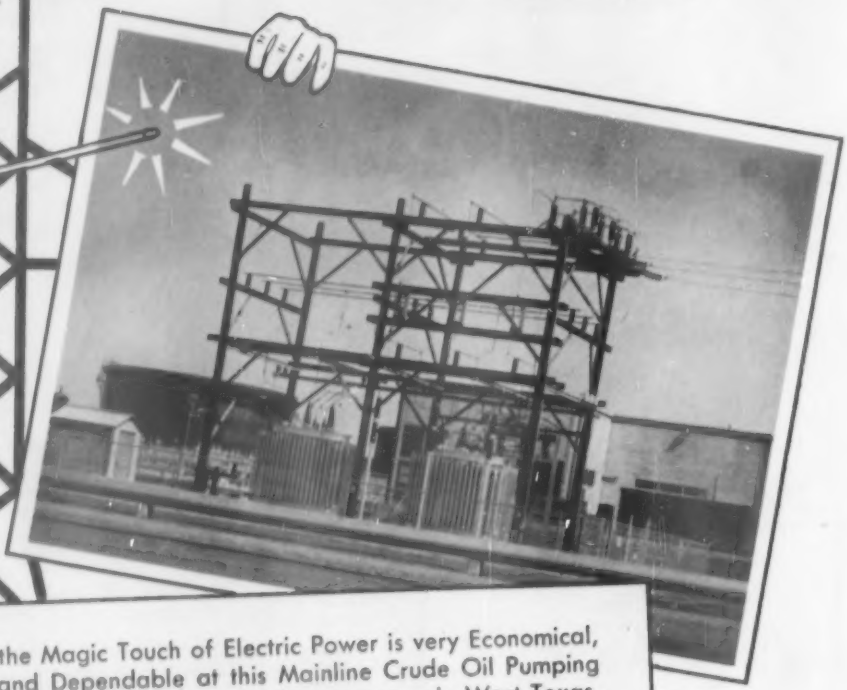
Outlet Boxes

The Magic Touch of

Electric Power

MEANS

ECONOMY, EFFICIENCY, DEPENDABILITY



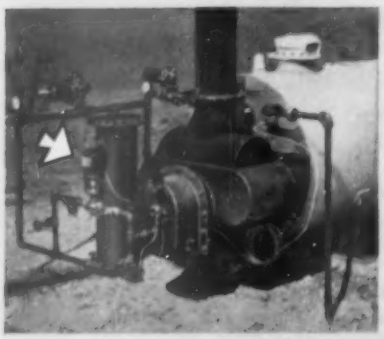
Yes, the Magic Touch of Electric Power is very Economical, Efficient and Dependable at this Mainline Crude Oil Pumping Station, operated by a large pipeline company in West Texas. In this station are three 3,000 H.P. and one 1,250 H.P. motors with over eighty Electrically operated valves. You can readily see that Low Cost Purchased Electric Power is doing a real job with its "Magic Touch." For the BEST ALL-AROUND POWER PERFORMANCE . . . SWITCH to Low Cost Purchased Electric Power . . . TODAY! For full details call your nearest Electric Power Company.

Petroleum Electric Power Association

ORGANIZED IN THE INTEREST OF GREATER SERVICE TO THE PETROLEUM INDUSTRY

CALL YOUR NEAREST ELECTRIC SERVICE COMPANY FOR MORE FACTS OR ADDRESS YOUR REQUEST TO P. O. BOX 2771, DALLAS, TEXAS

USED BY LEADERS IN THE INDUSTRY



Want Safe, Reliable Control for Your Field Processing Equipment?

Install POWERS

No. 11-OFT Self-Operating Temperature Regulator

✓ Check these features that give Economical Trouble-free Performance — in all kinds of weather

1) Thermal system has OVER-heat protection. Powerful two-ply bellows and single seat composition disc valve assures tight shut off.

2) Valve stem lubricator helps give closer control, reduces packing gland troubles.

3) Rugged, built for long reliable service in all kinds of weather. Operate efficiently down to 60° F. below zero.

4) Durable Valves are direct acting, have single seat bronze body with double unions, for easy installation, composition disc and stainless steel seat.

5) Temperature adjustment range: 110 to 190° F., other ranges between 30 to 370° F.

6) Bulb Well is cadmium plated steel and extra heavy plain capillary tubing is 10 ft. long.

Powers No. 11 Regulators are backed by over 60 years experience making *SELF-OPERATING* controls. They are used by leading manufacturers of heaters and treaters.

Simplify Your Control Problems—Standardize on Powers

[b47]

POWERS CONTROL

THE POWERS REGULATOR COMPANY

SKOKIE, ILLINOIS • Offices in Over 50 Cities in U. S. A., CANADA and MEXICO

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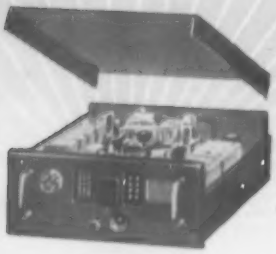
OVER 60 YEARS OF AUTOMATIC TEMPERATURE CONTROL

A GREAT 450 MC UNIT

"Guarantee

G-E 2-WAY RADIO...YEARS AHEAD WITH SELECTIVITY

GUARANTEED FOR LIFE!



2-WAY MOBILE RADIO

SELECTIVITY GUARANTEED FOR LIFE!

✓ **SELECTIVITY GUARANTEED FOR LIFE...** New multi-coil IF transformers. Compare G-E specs *with any other!*

✓ **RESERVE POWER** at the station—40 watts output on all station equipment—continuous duty rating.

✓ **FULL 6/12 VOLT OPERATION.** Mobile unit functions from 6 or 12 volt source.

✓ **HIGH-Q CAVITIES** at *both* receiver input and output—your best insurance against TV interference.

✓ **4-CHANNEL OPERATION . . .** Here's *positive* assurance of performance on different frequencies!

✓ **290 KC LOW IF**—the right IF for mobile radio equipment!

SPARKS G.E.'s NEW *Policy* "

TODAY, as always, General Electric stamps its products with a quality brand. Here is not just another piece of mobile radio gear to satisfy consumer need . . . here is a standard of performance for the industry to follow. IF tuning . . . guaranteed for life! Your interests deserve nothing less than the criteria G.E. has established for mobile radio performance.

Examine every feature of this outstanding 450 MC equipment. Compare *power . . . reliability . . . maintenance requirements . . .* because the story of G-E's superior design is right there for all to see . . . for all to take advantage of. Get the G-E 2-way radio story today!

NOW! Get this guarantee policy when you purchase *any* new G-E 2-way radio . . . *regardless of type!*

Get full information from your local G-E district representative or write direct to: *General Electric Company, Section X854-10, Electronics Park, Syracuse, New York.*

You can put your confidence in—

GENERAL ELECTRIC

WECO COMPOUNDS

the BIG FOUR of thread protection

Whatever your requirements or preference in thread compounds, you can depend on getting highest quality when you specify a WECO Compound.

Each is non-hardening . . . free from the tendency to gum up . . . free of acid or other corrosive agents . . . unaffected by hot or cold weather . . . requires no thinner.

For maximum thread protection on tool joints, drill collars, bit joints, Christmas Tree assemblies and other high pressure services . . . for leak-proof thread connections on casing, tubing, steam lines, oil and gas lines, etc., be sure you choose a WECO Compound.

LO-TORK TOOL JOINT COMPOUND

Containing more than 50% pure metallic lead, Lo-Tork is the choice of those who prefer a lead base compound. Lo-Tork provides maximum thread protection for tool joints, drill collars and other high pressure assemblies under all conditions.

NO-GALL TOOL JOINT COMPOUND

No-Gall contains more than 50% pure metallic zinc, disbursed in a neutral oil with a tack additive to insure maximum thread protection. Those who prefer a zinc base compound have found No-Gall ideal for tool joint thread protection.

STEEL-AID THREAD COMPOUND

Containing 65% pure metallic lead, Steel-Aid meets the requirements of those who prefer a compound with a higher-than-average lead base. Steel-Aid will not squeeze out under extremely high torque or pressures.

HI-SPEED SEAL

Hi-Speed Seal provides a permanent non-hardening seal for casing, tubing, steam lines, oil and gas lines and other threaded connections. It seals with less torque . . . permits better make-up . . . easier break-out . . . prevents leaks, galling and stripping of the threads.

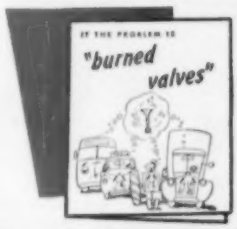
The new API High-Pressure Thread Compound is available from WECO.

it's wise to standardize with.. **WECO**

WECO® WELL EQUIPMENT MFG. CORP. • Division of Chiksan Company • HOUSTON 1, TEXAS

PETROLEUM CHEMICALS DIVISION
NEWS

May ★ One of a Series of Interest to the Petroleum Industry ★ 1954



Burned valves are rarely the fault of the fuel or oil

Yet, your fleet and farm account salesmen often have to take the brunt of valve-burning complaints. Now, the 4-page, pocket-size folder shown above can help you and your representatives get off the hook on these complaints.

Graphically illustrated by cartoon drawings, this folder explains why most valve troubles are the result of improper engine maintenance and operation. It discusses carburetor mixture settings, cooling system troubles, valve seating and other factors contributing to valve burning. Involved technical discussions are avoided. The copy is clear, simple and easy to remember.

For sample copies and information on how to obtain "burned valves" folders for your salesmen, ask a Du Pont representative or write to any Du Pont Petroleum Chemicals Division regional office.

Jet Fuel Research Program Initiated At Petroleum Laboratory

As the jet age advances at a fast pace, refiners are being confronted with new problems involving the combustion characteristics of jet fuels.

Operator at the control panel of the "Jet Room" in the Du Pont Petroleum Laboratory.

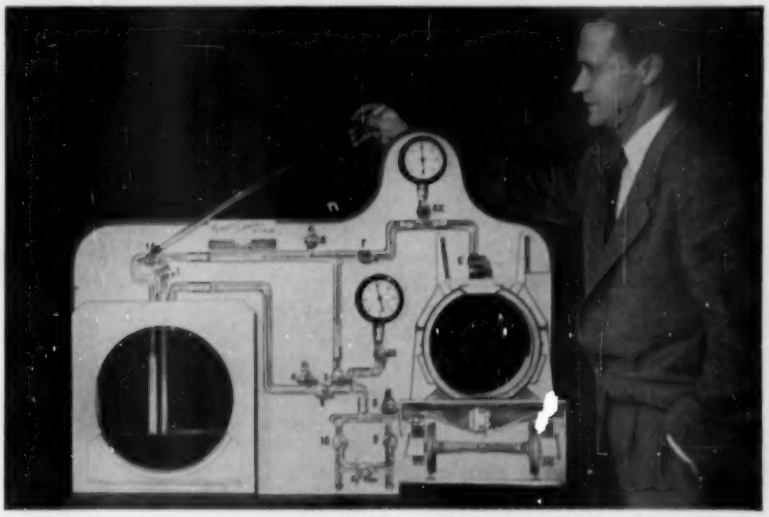
To help in the solution of these problems, the Du Pont Petroleum Laboratory has added new facilities for jet fuel research. These are currently being employed to study the effects of various additives for improving the performance of jet fuels. The present investigations are concentrated on three of the most pressing problems . . . (1) carbon deposition, (2) nozzle clogging, and (3) smoke.

This work on jet fuel additives is part of an extensive research program at the Petroleum Laboratory and other associated Du Pont laboratories.

Du Pont Develops Syphon Starter To Overcome Tetraethyl Lead Tank Car Unloading Problems

Syphon breaks caused by leaks in the vacuum system used for unloading TEL tank cars pose troublesome unloading problems. The development four years ago of the Du Pont Metal-Flex unloading hose has helped to overcome most of the difficulties where smaller weigh tanks are used.

However, the current use of larger weigh tanks and gasoline of higher Reid Vapor Pressure has, in many cases, made it difficult and often impossible to create enough vacuum to unload the bottom portion of the tank car directly into the weigh tank. This difficulty generally results in considerable loss of time and efficiency.



Tank car unloading operations are exactly simulated by this scale model. The weigh tank is on the left and the tank car on the right. Mercury is used in the model to simulate tetraethyl lead compound.

But it is now possible to solve this unloading problem quickly and easily with the aid of a specially-designed "syphon starter."

Developed by Du Pont

Du Pont engineers and technical representatives were frequently called upon for help in solving unloading difficulties at customer plants. Determined to lick the problem, one of these men went to work and came up with the solution.

As a result, a new Du Pont-designed standpipe that acts as a syphon starter was developed.

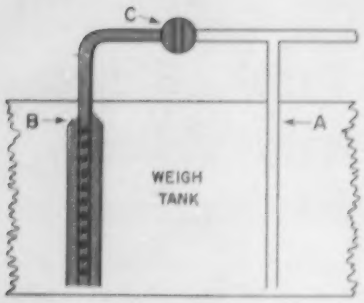
OVER

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

PETROLEUM CHEMICALS DIVISION
NEWS

CONTINUED

Syphon Starter



This diagram explains the basic principles in the Du Pont syphon starter system. "A" represents the standard standpipe. "B" indicates the perforated standpipe and shield. "C" is the syphon starter valve.

Getting the last drop

Suppose you have a weigh tank which you would like to fill to capacity. You can unload one tank car of TEL compound into it quite readily. But by the time you work down to the "heel" of the second carload, your troubles begin. Only too frequently that last 1,000 lbs. or so of TEL compound just won't syphon out of the tank car.

What has happened? For some reason or other, your syphon has broken. This is most likely caused by air getting into the system from a packing gland leak around a valve or a vortex forming in the compound at the bottom of the tank car.

When the syphon breaks at this point, it is generally difficult and often practically impossible to re-establish it.

What can you do?

In the past, any one of several alternatives has had to be employed to finish the unloading operation. One is by priming the line. You re-establish the syphon by bleeding in gasoline from the circulating system. The disadvantage of this method is, of course, that the TEL compound is diluted and your blending formula upset.

Sometimes it is possible to prime the line by an elaborate manipulation of valves which alternately connect the tank car to the eductor and then to the weigh tank. This method usually requires several operators and may put compound directly into the gasoline instead of the weigh tank.

On the other hand, you might choose to take the TEL directly from the tank car into your circulating gasoline system. But here again your blending calculations are upset and have to be refigured.

Another alternative would be to transfer some of the TEL compound out of the weigh tank and into some other storage tank.

But all of these methods result in a waste of man hours and a loss in refinery efficiency.

The Starter

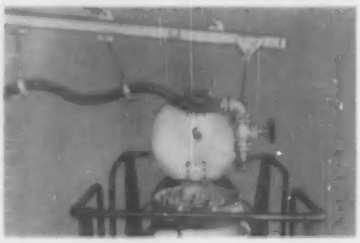
Now, whenever your syphon breaks at a point where it is difficult to get started again, the Du Pont syphon starter comes to your rescue.

The starter itself is an auxiliary standpipe. But it differs from the standard standpipe in that it is perforated. This means that it takes full advantage of the vacuum above the liquid level.

But being perforated, the standpipe has to be designed to prevent the build-up of a static charge which could be explosively dangerous since there is a chance that a gasoline and air mixture may be present in the tank. To guard against this danger, the perforated pipe is surrounded by an outer shield of tubing. The two units are welded together with a series of bracer members.

Because of its potential for increasing unloading efficiency, you will want to know more about the new Du Pont-designed syphon starter. We suggest you discuss it with a Petroleum Chemicals representative, or address your request for further details to the regional office of the Petroleum Chemicals Division in your area.

Metal-Flex Unloading Hose Another Du Pont Contribution To The Eductor System



In TEL tank car unloading operations, leaks—although they may allow only a small amount of air to enter the vacuum system—are the most common cause of syphon breaks.

It was to help prevent these leaks—as well as to add convenience to unloading operations — that Du Pont developed the Metal-Flex unloading hose several years ago. Because of its easy flexibility, it eliminates the binding which tends to cause gland leaks on rigid lines. This also eliminates the need for many costly, hazardous gland repacking jobs.

In fact, hardly any maintenance is required to keep the hose in working condition. This, added to the fact that only one man is required to connect and operate it, means that the Metal-Flex installation more than pays for itself in added efficiency within a very short time.

DU PONT

Better Things for Better Living
. . . through Chemistry

Petroleum Chemicals

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Petroleum Chemicals Division • Wilmington 98, Delaware

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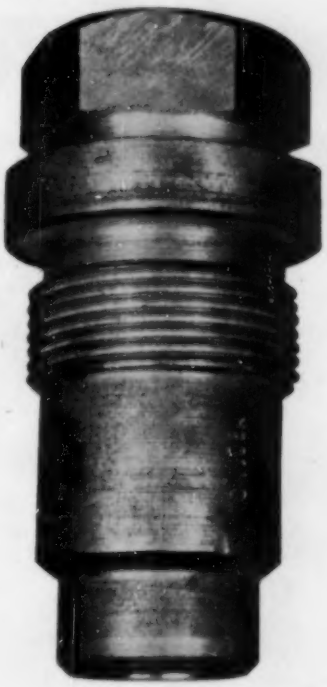
A-7240

Printed in U. S. A.

This stem seat of plain carbon steel, removed from an Adjustable Wing Valve after only 45 days of service on a gas-condensate well, graphically illustrates the seriousness of corrosion.

After 7 years of continuous service on the same well, this stem seat of UNIBOLT "SA" Stainless Steel shows little, if any, harmful effect of the gas-condensate corrosion.



If CORROSION is your problem

UNIBOLT "SA" Stainless Steel Christmas Tree Fittings may provide the answer. For the past seven years, in cooperation with a major oil company, UNIBOLT engineers have experimented with various stainless alloys to determine the one most resistant to gas-condensate corrosion. The un-retouched photographs above of identical parts tested on the same well clearly indicate the wisdom of selecting UNIBOLT "SA" Stainless Steel Fittings for corrosive conditions.

UNIBOLT "SA" STAINLESS*

THORNHILL CRAVER CO.

P. O. BOX 1184 HOUSTON, TEXAS

* Special Analysis, Special Heat-treatment

Another machine has been added to the "KOEHRING Work Capacity" team

NEW KOEHRING 15-TON ½-yd. 205

LIFTS 15 TONS on rubber
With its maximum 15-ton lift capacity, this new Koehring 205 Truck Crane brings you a big *plus* in work capacity at "½-yd." price.

LIFTS 10 TONS on crawlers
As a crawler crane, heavy-duty 205 has 10-ton capacity . . . and boom lengths from 30 to 50 feet.

½ TO ¾-YARD clamshell or dragline
Extra work capacity lets you handle ½ to ¾-yd. clamshell or dragline buckets on wide work range.

½-YARD dipper capacity
This 205 is also available as ½-yd. shovel or hoe. Hoe digs 17¾ feet deep . . . up to 32 inches wide.

WITH ANY ATTACHMENT HERE'S WHAT YOU GET:

- On rubber-tired mounting, 32½ m.p.h. travel speeds.
- On standard or extra-long crawlers, 16, 20 or 24" shoes.
- Automatic traction brakes on crawlers.
- Only 2 major shafts in upper machinery.
- Antifriction power flow for dig, lift, swing, and travel.
- 4 separate adjustable hook-rollers.
- Big 20" clutches, self-adjusting.

Before you invest in any excavator or crane, see your Koehring distributor about this new 205, or write us.

K45 OGJ

To KOEHRING CO., Milwaukee 16, Wis.
Send us bulletin on the new ½-yard, 15-ton 205.

NAME _____ TITLE _____
COMPANY _____
STREET _____
CITY _____ STATE _____

KOEHRING
COMPANY • Milwaukee 16, Wis.
Subsidiaries: PARSONS • KWIK-MIX • JOHNSON

Have you compared costs of weed control lately?

It's economical because it's simple and long-lasting when you use

Du Pont "Telvar" W

Weed Killer

Around tanks and other key areas "Telvar" W gives long-term control of vegetation... which reduces fire hazards.

One spraying of as little as 40 to 60 pounds of Du Pont "Telvar" W per acre can get rid of vegetation *for a growing season or longer!* This powerful weed killer kills through the roots . . . remains in the ground to prevent new growth. Its lasting chemical action is just what's needed around wells, tank farms, refineries, pumping stations and pipelines.

Savings for You

With "Telvar" W on the job, you'll save labor and maintenance costs. A single spraying takes the place of laborious cutting and mowing . . . expensive multiple spraying. You eliminate the problem of storing and handling bulky weed killers, too. It all adds up to new efficiency in weed control—new economy in keeping key areas neat and trim.

Easy and Safe to Use

"Telvar" W is a wettable powder that mixes readily with water and is low in toxicity to humans and animals. Non-volatile and non-corrosive, it can easily be applied by standard spraying equipment. And "Telvar" W is non-flammable—particularly important in oil-field application.

DU PONT TELVAR W

REG. U. S. PAT. OFF. TRADE-MARK

Weed Killer

BETTER THINGS FOR BETTER LIVING ... THROUGH CHEMISTRY

Your Custom Sprayer Can Help

Specify "Telvar" W for this year's weed-control program. If you don't have spraying equipment, get in touch with a reliable custom sprayer to do your weed killing on an annual basis.

We can help you contact the Custom Sprayer in your area and give you more information on Du Pont "Telvar" W Weed Killer.

Mail This Coupon for Free Booklet

E. I. du Pont de Nemours & Co. (Inc.)
Grasselli Chemicals Department, Rm. D-4026
Wilmington 98, Delaware

☐ Please send me your booklet describing positive weed control with "Telvar" W. ☐ Send me the name of my nearest supplier.

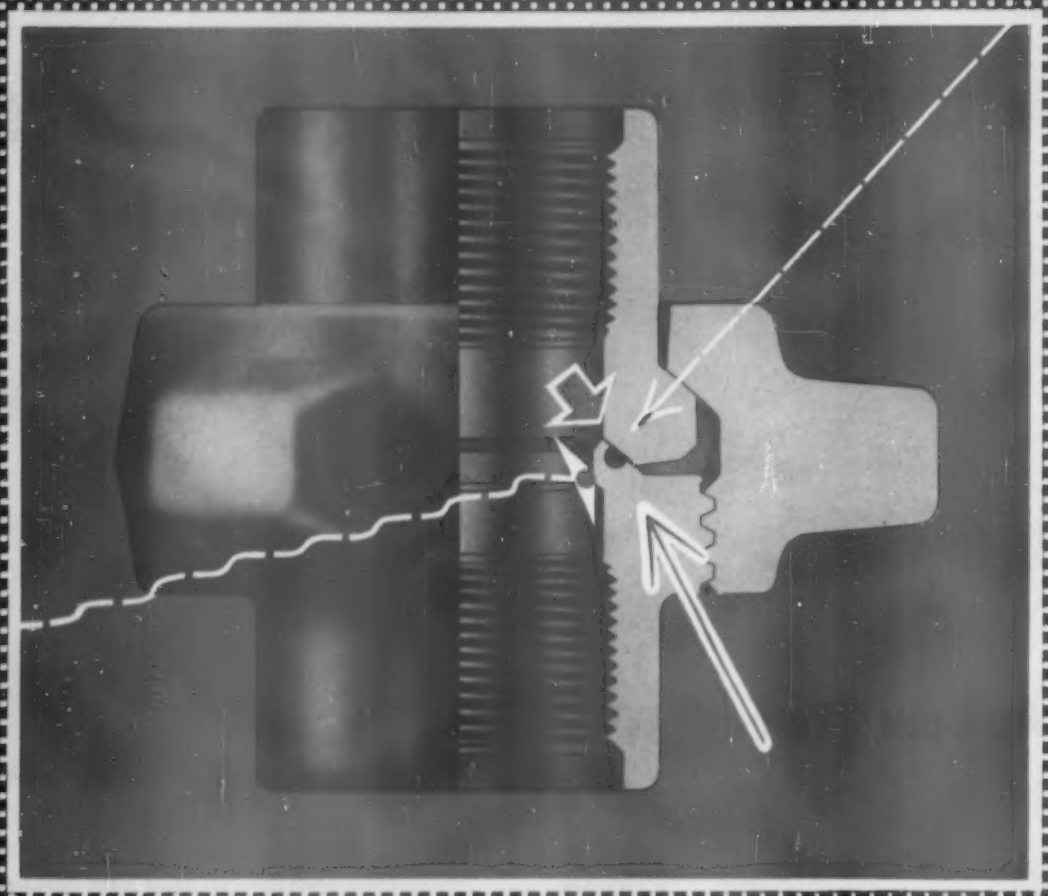
Name_____ Position_____

Firm_____

Address_____

City_____ State_____

On all chemicals always follow directions for application. Where warning or caution statements on use of the product are given, read them carefully.



did you know O-C-T makes the "O" ring union that may be used to full rated pressure with or without the "O" ring

Here is another reason why O-C-T Type CO unions are tops in performance on your steam and high pressure lines. Impartial tests have praved these unions to be equally efficient at holding high pressures either with or without the "O" ring.

And it will hold high pressures with the nut only hand tight. Because of the ball seat feature, which provides for a misalignment of five degrees or one inch in one foot in any direction from center line, pipe need not be forced into perfect alignment in order to tighten the nut—as must be done with conventional wing unions.

Make sure of better connections on your lines. Ask your supply store about O-C-T Type CO Acme Ball Seat Misaligning Unions. Available through more than 700 supply store locations.

OIL CENTER TOOL COMPANY· HOUSTON, TEXAS

Announcing the POWRWORKER "26"

Feature by feature, it's engineered to meet your own handling requirements

Detailed job-studies in customer plants, warehouses and terminals dictated the features of the POWRWORKER "26". No truck on the market today can match the POWRWORKER'S combination of *user-benefits*:

Maximum Maneuverability—Only 26" longer than the load, the shortest standard truck on the market.

Light Weight—Completely fabricated construction combines maximum strength with least weight.

Stability—Close-to-the-floor, low center of gravity

Great Efficiency—Double reduction of spur gears gives maximum ton-miles at least power cost.

Balanced Load Distribution—Double lift cylinders for smooth lifting and lowering.

Safety—Deadman switch cuts power when brake is applied, handle automatically returns to brake-position.

Easy to Service—All operating units accessible without lifting or dismantling. Drive wheel tire is quickly demountable.

We invite you to compare the 1954 POWRWORKER with any truck on the market! For details, call your local Clark dealer, listed in the Yellow Pages. Or send the coupon for literature.

Ask your Clark dealer about Clark's low-cost Pay-As-You-Go leasing plan.

CLARK EQUIPMENT

POWRWORKER SECTION
Industrial Truck Division
CLARK EQUIPMENT COMPANY
Battle Creek158, Michigan

☐ Please send POWRWORKER literature. ☐ Have representative call.

Name_____

Firm Name_____

Street_____

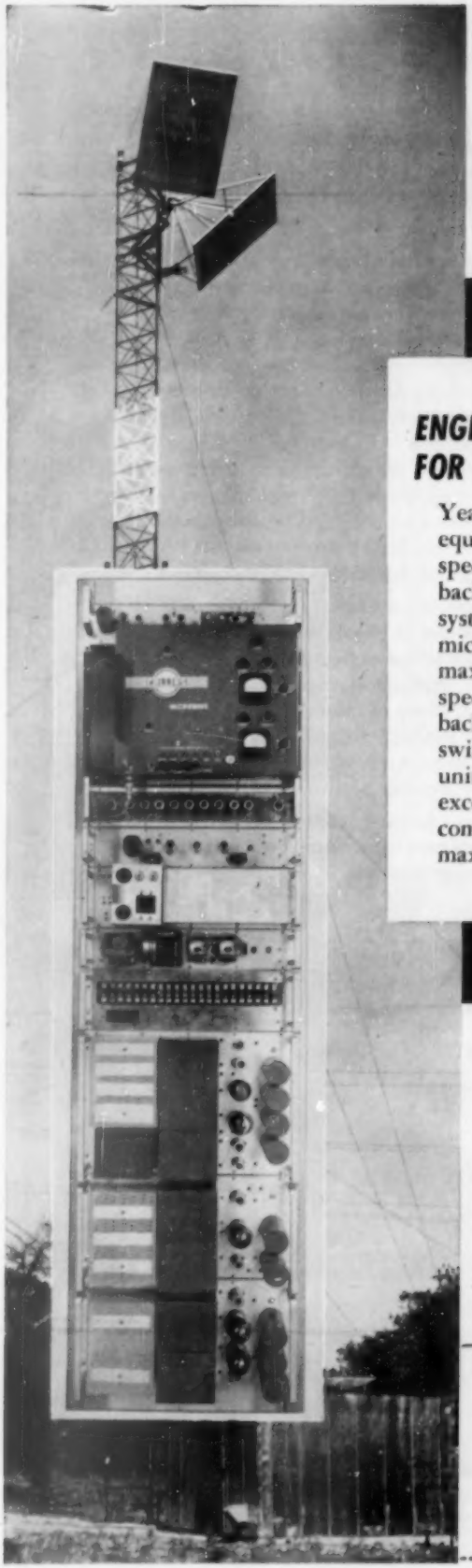
City_____ Zone_____ State_____

No special glasses needed for our 3D*

You can easily see the advantages of the 3-D ... 3-Diameter Pin...used in Rex A.P.I. Oil Field Chains. Three individual diameters... *one* under the pin head...*two* on the bushing bearing area...*three* on the cotter end... assure fast, easy field assembly and disassembly. It is necessary only to drive the pin the thickness of a single sidebar. No need for heavy battering with sledge and drift pins. Yet, there is no sacrifice in strength, bearing area or pin life. The Rex 3-D Pin is but one of the many advantages that make Rex A.P.I. Chains "the favorites in the fields." For the complete story, see your supply store or write Chain Belt Company, 4619 W. Greenfield Ave., Milwaukee 1, Wis.

CHAIN BELT COMPANY

District Sales Offices and Distributors in all principal cities



COLLINS MICROWAVE

ENGINEERING EXCELLENCE BUILT IN FOR MAXIMUM RELIABILITY

Years of supplying advanced radio-electronic equipment for aviation, broadcasting and specialized industry give Collins the required background for providing ideal microwave systems for the oil and pipeline industries. Collins microwave uses unit type construction for maximum installation flexibility to meet a user's specific needs. All equipment is mounted back to back on standard relay racks. Articulated swing-out hinges permit access to the rear of the units. Advanced design, built in engineering excellence and conservatively operated components assure superior performance and maximum reliability.

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COLLINS RADIO COMPANY OF CANADA, LTD., 74 Sparks St., Ottawa, Ont.

SEND this coupon today for complete technical information.

Please send me complete information on Collins Microwave.

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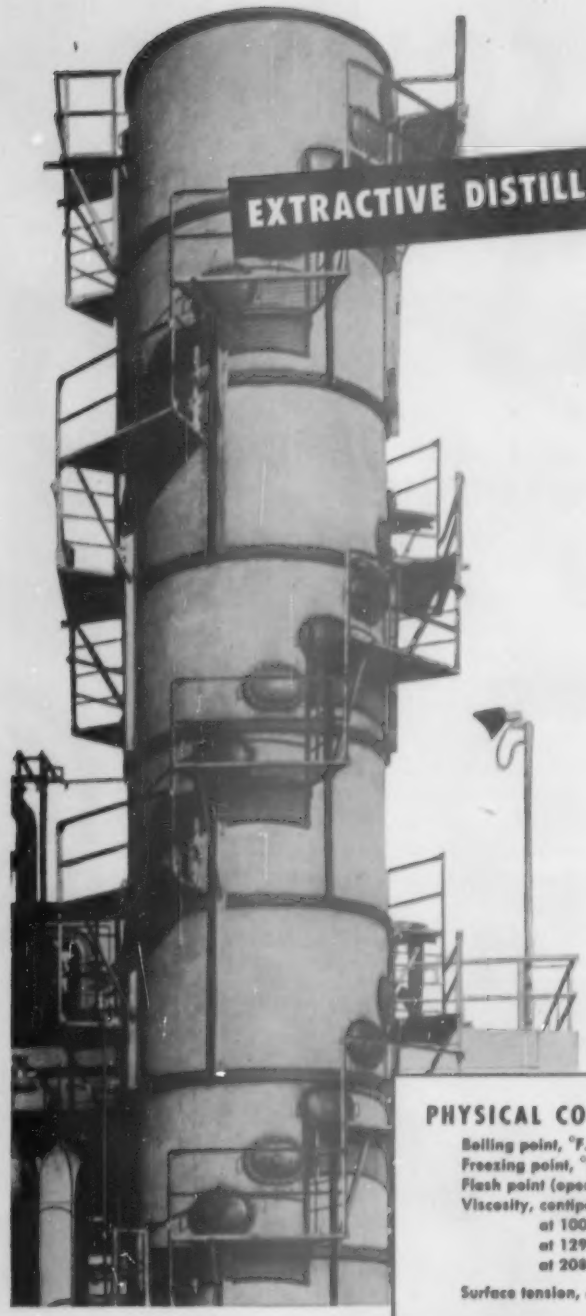

EXTRACTIVE DISTILLATION CALLS FOR FURFURAL

Furfural has a long history of successful use in the purification of such high boiling materials as petroleum lubricating oils, wood rosin and vegetable oils by means of liquid-liquid extraction. Furfural has also been used successfully in separating lower boiling compounds by means of extractive distillation. For example, in the separation of C_4 hydrocarbons for the recovery of butadiene the addition of furfural alters the normal relative volatility of the several compounds in such a way as to make possible good separations with reasonable equipment size and low steam consumption.

Extractive distillation using furfural can be extended to include the recovery of benzene and other aromatics from petroleum fractions. Furfural has the desirable properties of good selectivity, high degree of thermal stability, ease of recovery, low freezing point, and relative non-toxicity. In addition, it is low in cost and is derived from raw materials which are replaceable yearly.

If you have a problem involving the separation of hydrocarbon mixtures, investigate furfural. Your inquiry is invited.

PHYSICAL CONSTANTS OF FURFURAL

Boiling point, °F.	323
Freezing point, °F.	—34
Flash point (open cup), °F.	134.2
Viscosity, centipoises	
at 100 °F.	1.35
at 129 °F.	1.09
at 208 °F.	0.68
Surface tension, at 20°C, dynes/cm.	49

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Room 539P, 120 Wall St., New York 5, N. Y.
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YO' JOHNSTONS WINS TH' SAFETY AWARD, AGIN!!-YO' TESTED MORE WELLS THAN ANYBODY!!
NATCHERLY!!-US JOHNSTONS SPESHULIZES IN DRILL-STEM TESTIN', WIF OUR SPESHUL EE-KWIP-MUNT!!
HE IS AVAILABLE, AN'AH IS ACCURATE!
YO' GITS US BOTH, WHEN YO' CALLS JOHNSTON— ANYTIME— ANYWHAR!!
WE CUTS LOST DOWN-TIME TO A MINNY-MUM, MUM!!
WE IS LOSIN' TIME, NOW!!-TH' MOON'S UP!!
SORRY!!—US JOHNSTONS GOT NO TIME FO' NOTHIN' BUT OIL!!
Al Capp

C-542

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JOHNSTON TESTERS

first in drill stem testing

HOUSTON, TEXAS

LOS ANGELES, CALIF • CALGARY, CAN.

FORMATION AND CASING TESTING — JOHNSTON

Sure, that old pump still works,

but how much does it cost to keep?

That rugged old pump of yours may not be the bargain that it seems. Let's do some arithmetic. If the efficiency of the old pump is 75% vs. the 85% efficiency of the new pump, you are paying more to keep it than you would to replace it. That's because a new unit of equivalent output uses less power. Thus it soon saves its own cost — then begins to pay dividends.

Let's take a specific example—a general service pump

Old pump efficiency 84%	625 BHP
New pump efficiency 89%	590 BHP
	35 BHP Saving

On the basis of 1¢ per KWH, the 35 BHP saving for a 5000-hour year (approximately 14 hours per day) amounts to $1300. This saving, capitalized in 4 years at 4% adds up to $5520. Yet the price of the new pump that saves $5520 is only $4054.

What would the pump replacement profit be in your particular case? Your De Laval representative can tell you exactly — in dollars and cents — as soon as he has the basic facts on your present installation. Call him in today or write to De Laval for Pump Fax Bulletin which includes a valuable "power-savings" chart.

DE LAVAL *Pumps*

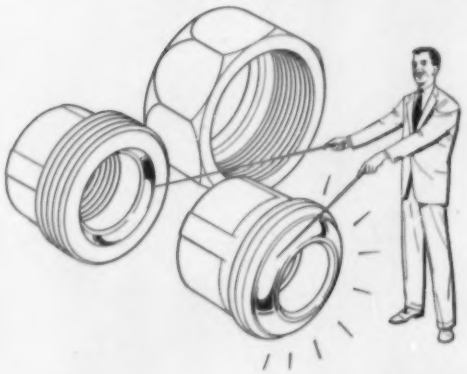
DE LAVAL STEAM TURBINE COMPANY
810 Nottingham Way, Trenton 2, New Jersey

DL-117C

Now!

A revolutionary new feature...

Hardness-Differential



built into seats of new Union #603

The first steel Union on the market of this type!

Special heat treating now makes possible the Hardness-Differential you've been wanting. *No other Union has this differential.*

The male seat of the new Rockwood Union #603 is specially heat treated to give it a greater degree of hardness than the female seat.

As a result, you get —

No galling in "making up" — longer service.

You also get —

Seats forged in place and double-locked under 100,000 and 400,000-pound pressure. Both seats are made of corrosion-resistant AIST molychrome steel.

Exclusive Rockwood cold forging process results in higher resistance to tough working conditions, expansion and contraction, shock, jar, vibration. Cold forging also results in absolutely interchangeable parts — pipe fitter won't scratch or damage seat in making up in tight places because of plug type ball-to-cone design — eliminates sharp corners or edges.

Exclusive "Rockwoodizing" — a special Rockwood coating process, applied after threading, protects entire union, including threads against corrosion.

Get the seats with the Hardness-Differential built right in. Mail coupon today.

ROCKWOOD SPRINKLER COMPANY

WORCESTER 5, MASSACHUSETTS

ROCKWOOD

ROCKWOOD SPRINKLER COMPANY
104 Harlow Street
Worcester 5, Mass.

Please send me prices and further data on the new Rockwood Union #603. I would also like the name of the nearest Rockwood distributor.

Name .....

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Company .....

Street .....

City ..... Zone ..... State .....

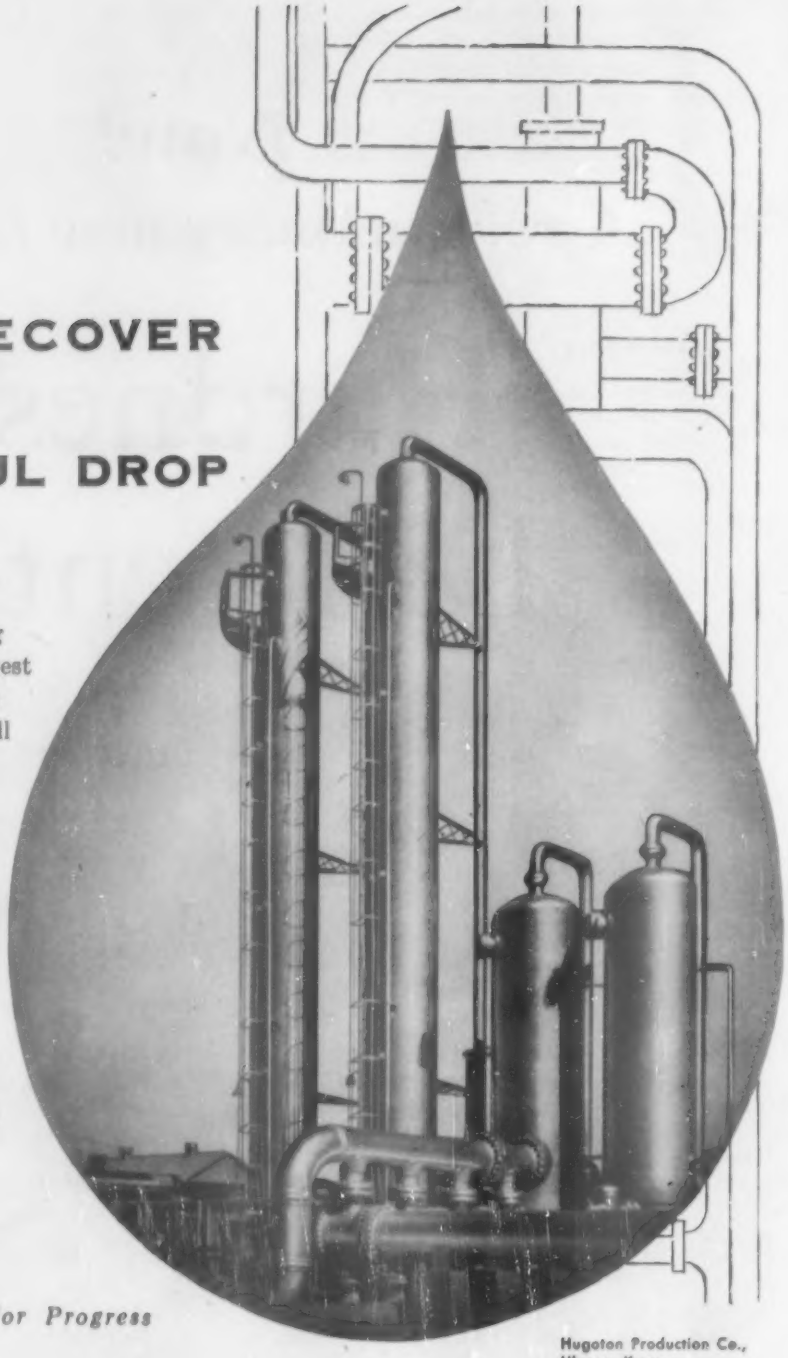
HOW TO RECOVER

EVERY USEFUL DROP

...without wasting a cent!

The complex problem of obtaining maximum recovery with the lowest possible investment and operating costs means that exceptional skill and experience is required in the design, engineering and construction of your natural gasoline plant.

J. F. Pritchard & Co. has supplied those unique skills to industry leaders for more than a quarter of a century...has proved—*by doing*—their outstanding ability to provide the same efficient processing facilities for you.



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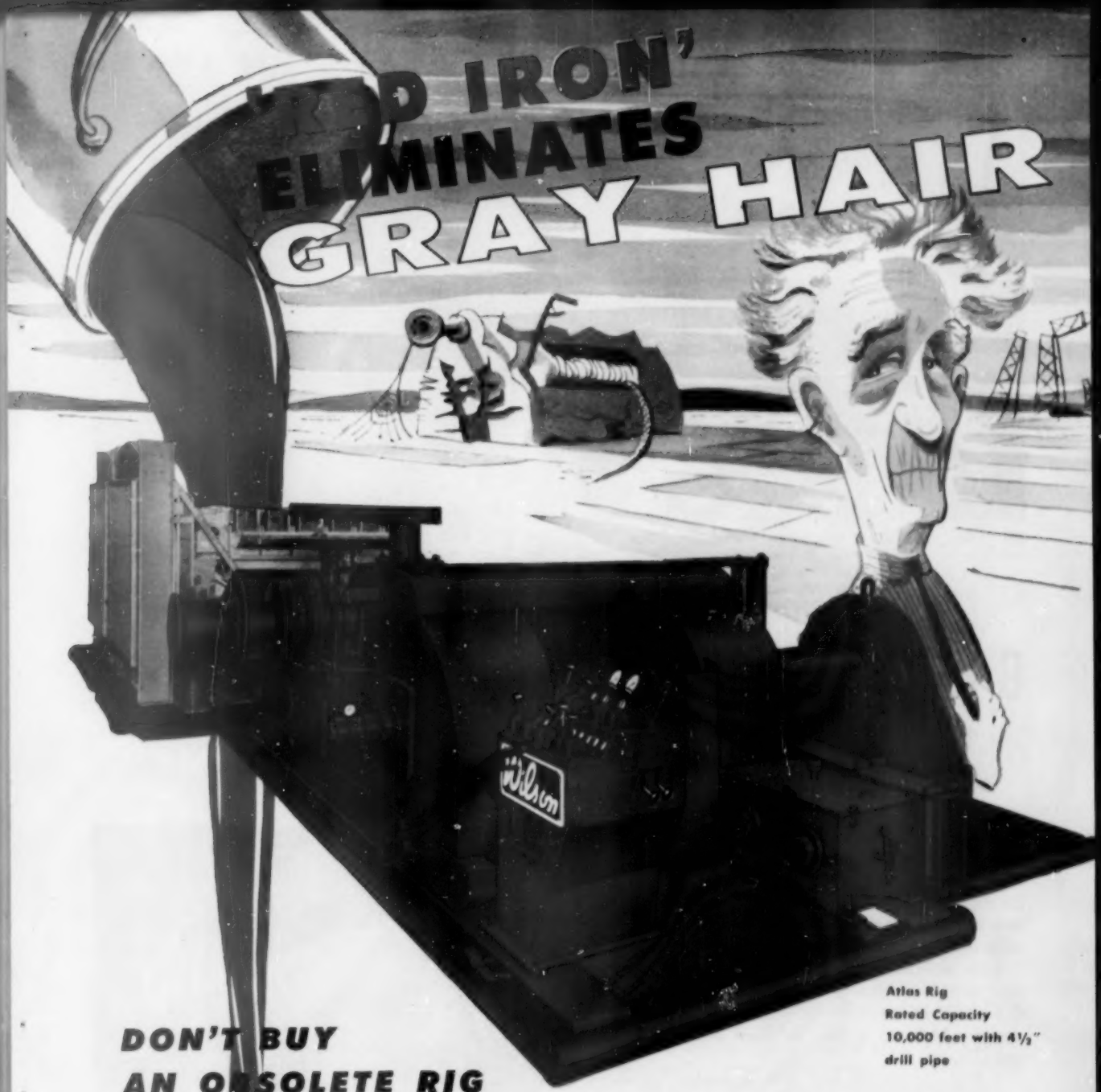

Atlas Rig
Rated Capacity
10,000 feet with 4½"
drill pipe

DON'T BUY AN OBSOLETE RIG

BE MODERN-BUY WILSON!

First choice with Drilling Contractors . . . Best Friend of the Auditors. Wilson — the FIRST NAME in DRILLING RIGS! The only compound rigs with EIGHT SPEED, ALL-FRICTION DRIVES. Wilson . . . the Power Rig Pioneer . . . is still years ahead of the field.

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The HOME of RED Iron • WICHITA FALLS, TEXAS, U.S.A.

TRI-CLAD* VERTICAL explosion-proof motors, like these belonging to Pan American Pipe Line Company and located adjacent to Rancho Pipe Line System's Eldorado Station, are available to suit the requirements of the pump mounting. This is just one of G-E's complete line of pipe-line motors.

TOTALLY ENCLOSED EXPLOSION-PROOF motors have been tested and listed by Underwriters' Laboratories for Class I Group D hazardous locations. Like this one at Sinclair Pipe Line Company's Clinton Station, they withstand all weather conditions, do not require firewall.

G-E Pipe-line Motors Can Help You Reduce Your Maintenance and Inspection Costs

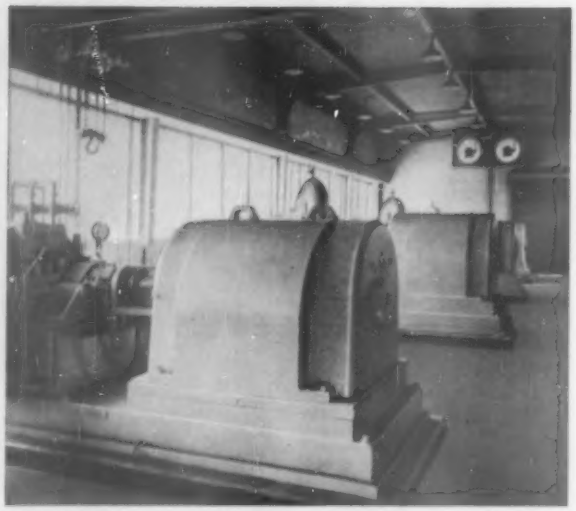
For the vital, continuous service which pipe line pumping requires, specify G-E motors. You can install them in your isolated stations and forget them for months at a time—because their rugged construction and high quality materials are designed specifically for long, dependable life in pipe-line service.

Wide selection offered by G.E. assures you the best motor for the job. For special applications, G.E. has the engineering experience necessary to design and build motors to meet your special requirements.

G.E.'s application and field engineers can serve you as a staff of experts on all your electric pipe-line equipment—to give you a co-ordinated, well-balanced system. And no matter where your pipe line reaches, you'll find G-E sales and service facilities all along its path to help you keep your throughput at a maximum under all conditions.

For more information, contact your G-E Apparatus Sales representative. *General Electric Company, Schenectady, N. Y.* 210-2

*Reg. trademark of General Electric Co.

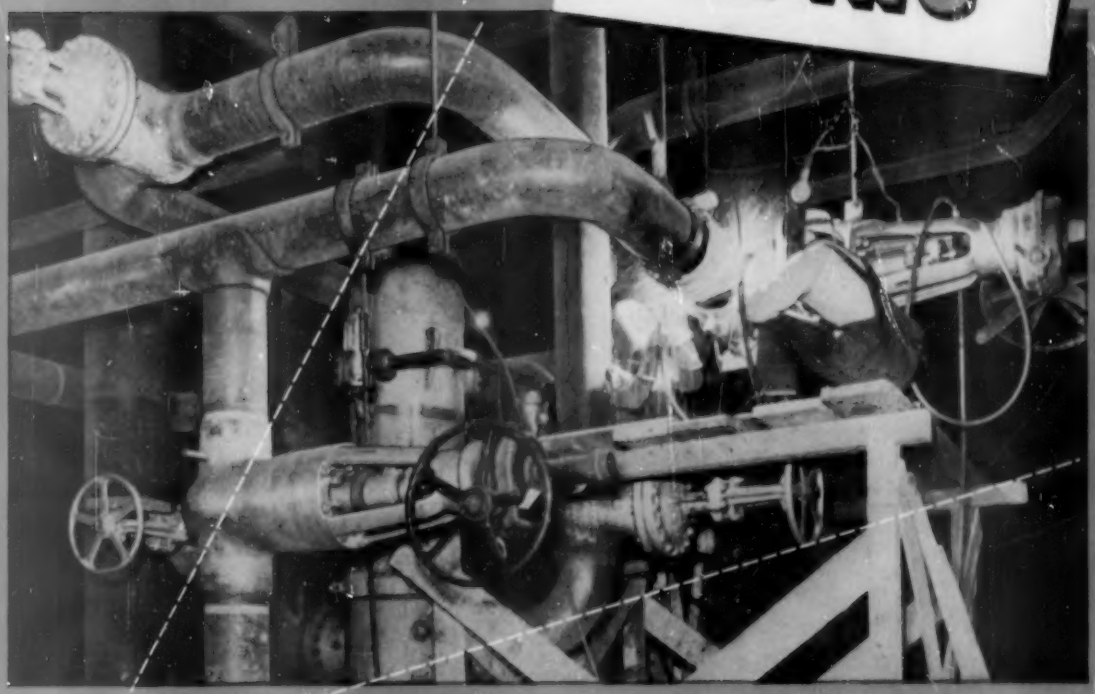


BASE-VENTILATED MOTORS up to 3000 hp may be force-ventilated like these at Rancho Pipe Line System's Garfield Station. Separate blowers are started in advance to purge motor and duct system.

GENERAL ELECTRIC

THERE IS

MUCH MORE TO MIDWEST PIPING



THAN MEETS THE EYE

Here you see carefully qualified Midwest welders erecting the boiler feed piping in a new public utility steam-electric generating station. What you don't see are the many other highly skilled men who contribute to the high quality of Midwest Piping.

First, there are the expert piping engineers who prepare the job for fabrication. They simplify the field work and make sure the difficult operations are done in the shop. And they often make suggestions that improve the design and reduce the cost of the piping.

Then there is the experienced shop organization (working with the most modern equipment) that delivers to the field subassemblies which are accurate in dimension, correct in alignment, thoroughly cleaned, heat treated when necessary, carefully inspected and tested . . . ready for erection at lowest cost. Both the shop and field supervisory personnel have come up through the ranks and know every phase of the operations . . . how to assure the customer the most for his money when he buys Midwest Piping.

MIDWEST PIPING COMPANY, INC.

Main Office, 1450 South Second St., St. Louis 4, Mo.

PLANTS: ST. LOUIS, PASSAIC, LOS ANGELES, and BOSTON

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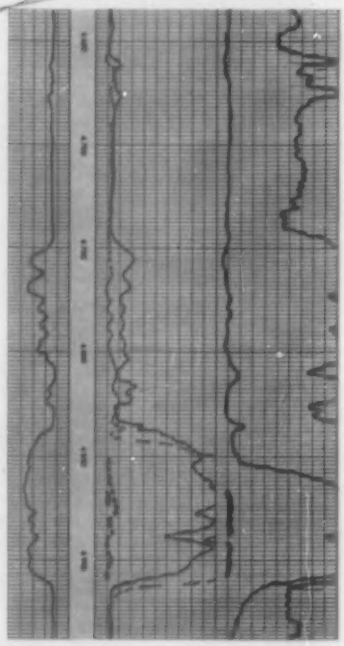
MIDWEST

PIPING FABRICATION and CONSTRUCTION

OFFERS YOU MANY BENEFITS

FM logs ARE WELL INFORMED

PROVE MORE ACCURATE FOR MANY IMPORTANT JOBS



Accurate well information is most important. Particularly, when you consider how many operations are dependent on data that can be furnished only by electric logging. Now logging can be used as an accurate aid in answering drilling, completion, production and recovery questions. And Halliburton's FM – frequency modulation–Logging furnishes well information for these essential operations with an accuracy unmatched by conventional electric logging methods.

FM accuracy makes it possible to "see" the producing zones of your well even where strata is narrow or intermingled with water. And secondary zones or minor oil sands, that may not be discovered by any other means, can be located. With this precise data at hand, you can safely cement off water zones and perforate only in selected producing areas.

FM Logging is a valuable aid in determining the thickness of oil beds and the comparative permeabilities of different portions of the formation. This information provides a factual basis for estimating the amount of oil available, the probable percentage of recovery and the rate of flow. And when used with pressure studies, FM logging data can help in predicting initial production.

Exact location of bottom of casing is another important application since even direct measurements taken while running casing may be thrown off by hole crookedness. And the FM Log is your surest method of locating those trouble spots where tools or pieces of casing are broken off during drilling and then sidetracked.

For all these operations, FM accuracy is your best guide to success. FM Logging, a Halliburton exclusive service, keeps you well informed by providing *more* data and *more accurate* data. Just phone your local or district Halliburton office. Or contact Halliburton Oil Well Cementing Company, Duncan, Oklahoma.

HALLIBURTON

ELECTRICAL WELL SERVICES

PERPETUAL PROGRESS IN PRODUCTION IMPROVEMENT TECHNIQUES

Wire rope?
What's that got to do with us?

A lot more than you might think, folks. Consider, for example, the heating in your home . . . the warmth that keeps *her* snug and comfortable through a wintry night. Whether you use coal, oil or gas—wire rope is an indispensable part of the equipment that probes the earth's depths to bring this comfort to you. Chances are, it may be Wickwire Rope. Because for over half a century Wickwire Rope has been an outstanding favorite with men in the mining and petroleum industries. Like users in numerous other lines of business, these men know that for unfailing performance, longer life and more economical service—there's nothing to match the quality and care that go into the making of WICKWIRE ROPE.

A YELLOW TRIANGLE ON THE REEL IDENTIFIES WICKWIRE ROPE

THE COLORADO FUEL AND IRON CORPORATION—Abilene (Tex.) • Denver
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Portland • San Francisco • Seattle • Spokane
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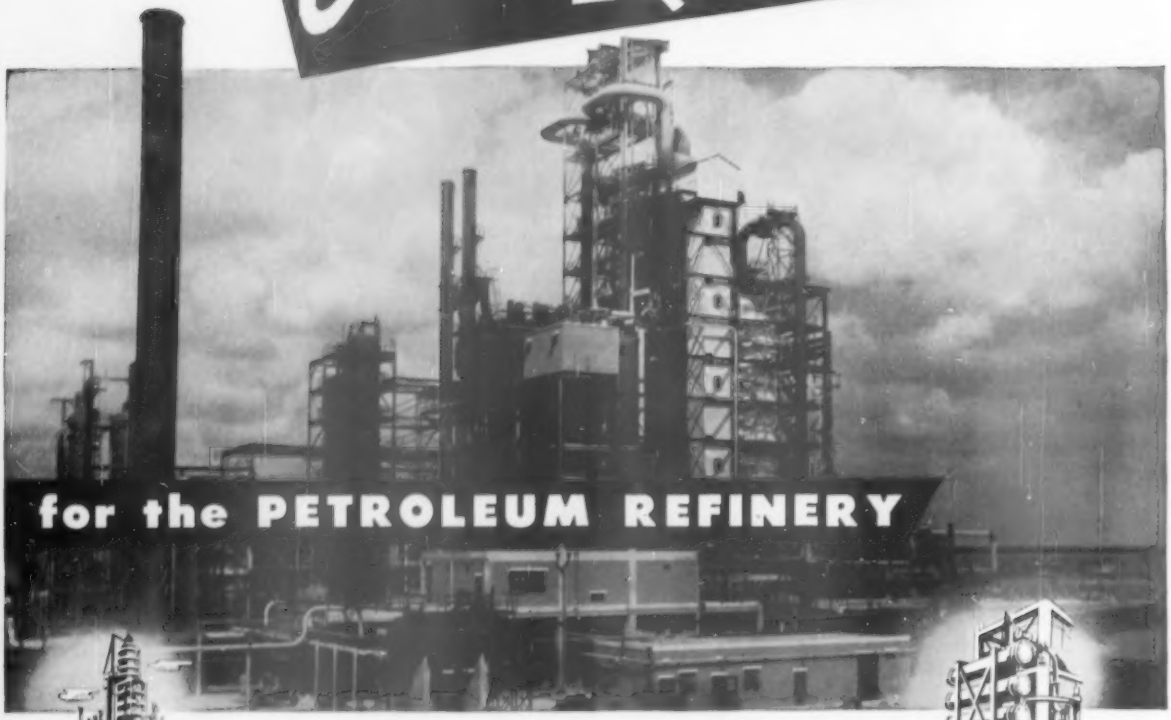
Chicago • Detroit • Emlenton (Pa.) • New Orleans • New York • Philadelphia

WICKWIRE ROPE

CF&I PRODUCT OF WICKWIRE SPENCER STEEL DIVISION
THE COLORADO FUEL AND IRON CORPORATION

1792

Essential EQUIPMENT



TOWERS—STILLS

STEAM BOILERS

DROP FORGED STEEL VALVES AND FITTINGS

SELECT the process most suitable to your operating conditions and indicated future market requirements and then specify . . . Equipment by Vogt.

A wealth of research and engineering experience, combined with skilled operating personnel and exceptional manufacturing facilities, is incorporated in the wide variety of equipment we construct to all Codes.

Inquiries for detailed information on Vogt Products will receive prompt attention.

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REFRIGERATION MACHINERY

WAX PLANT EQUIPMENT

HENRY VOGT MACHINE CO., Inc.

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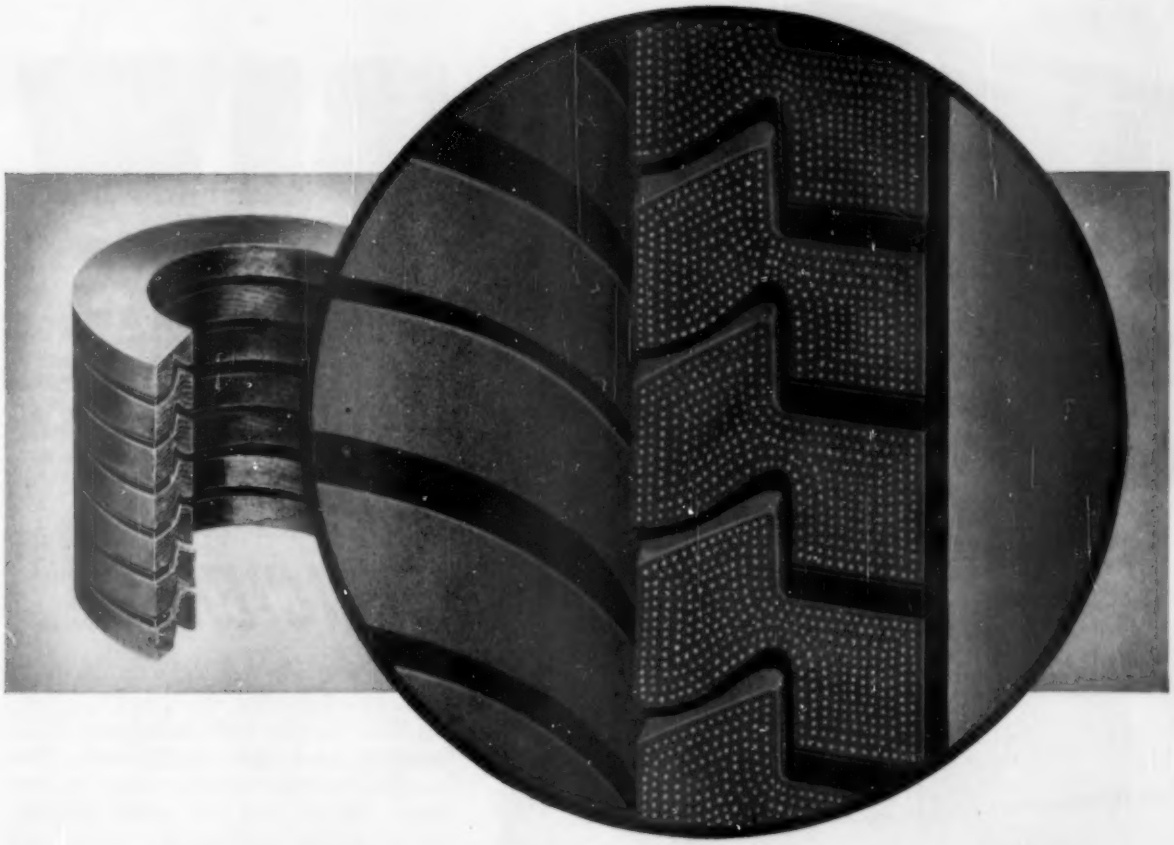
NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • ST. LOUIS • CHARLESTON, W. VA. • DALLAS



R/M "Vee-Square" mud pump packings need no sensitive gland adjustments

For heavy-duty service in the oil fields, you won't find better packings than R/M "Vee-Square"* Rings. They seal efficiently; are easier on rods; and, unlike ordinary V-ring packings, do not require sensitive, finger-tip adjustment.

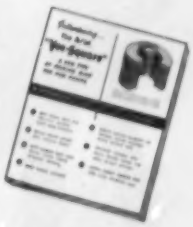
Take a look at the cut-away view of their construction. Note the solid square section—it absorbs gland pressure, keeps the packing from rolling and riding the rod. Note the V-design—it assures automatic sealing. Note the soft rubber cushion between the rings—it prevents blow-by and compensates for any overtightening.

*Patent pending

R/M MAKES A COMPLETE LINE OF PACKINGS AND GASKETS AND SELLS THEM ONLY THROUGH AUTHORIZED DISTRIBUTORS

R/M PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, MANHEIM, PA.

If lowering your mud pump rod costs interests you, write today for our free bulletin on R/M "Vee-Square" Packing Rings.



FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.; Neenah, Wis.; Crawfordsville, Ind.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Packings • Asbestos Textiles • Industrial Rubber, Engineered Plastic, and Sintered Metal Products • Abrasive and Diamond Wheels Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Bowling Balls

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BUILD GREATER DRILLING EFFICIENCY!

New, two way bearings on the Type KN Crown Block and the Type PN Traveling Block handle both radial and thrust loads as pure right angle loads. This design increases bearing capacity, reduces weight, and cuts space requirements. Longer bearing life results plus reduced maintenance and replacement costs.

The Crown Block can be hoisted through the water table in one piece. Because the center pin is on the center line of the beam, either flange of the beam can be set on the water table beams. The narrow width of the 300 ton capacity Traveling Block permits maximum pipe racking for deep drilling. With its low center of gravity, kicking or side lift is kept to a minimum. Bearings and sheaves are interchangeable between Crown and Traveling blocks.

Write for the complete story on what these blocks can do to cut your drilling costs, increase your drilling efficiency. Beaumont Iron Works, one of the oldest oil country manufacturers, builds a complete line of drilling and producing equipment.

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General Sales Office: 1404 Dunlavy St., Houston 19, Texas
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They Say—

Return to Normal

"Towards the end of last year some change in the tempo of business was becoming evident. Industrial employment had dropped slightly below the level of a year earlier. Both at home and abroad there was indication of increased competition for markets. This change in economic climate most likely portends to return to more normal relations between buyer and seller and to a market where quality and price are as important as the ability to supply."

J. R. White, president of Imperial Oil, Ltd., Toronto, in the company's annual report.

Vigorous or Vicious

Vigorous competition is characteristic of the petroleum industry, but such competition can, and sometimes does, take unhealthy forms.

"For example, in the effort to dispose of gasoline surpluses we see a constant trend toward over-emphasizing the octane ratings of motor gasoline beyond the needs of all but a few of the motor vehicles on the road today. We also face the threat that the excess refining capacity, which was created specifically for defense purposes, will be used only to gain competitive advantages with the result that some other capacity will be lost and will thus leave us with less than the expected amount of excess capacity for a time of emergency."

A. W. Scott, president of the National Petroleum Association, in an address before the association's spring meeting.

Faith in the Future

"There are two basic facts about the oil industry which we should bear in mind: (1) It is a growth industry. By that I mean that year after year the demand for oil products has increased, and the saturation point is not in sight, and (2) The demand for oil products is not as sensitive to general business fluctuations as is the demand for many other commodities.

"Last year we spent $237,712,000 in the search for more oil reserves, for building new refinery units and chemical plants, for new pipelines, additional storage capacity, bulk terminals and service stations, and for countless smaller tools and equipment. As it looks

The Only Reproduction Machine That Gives You All 7

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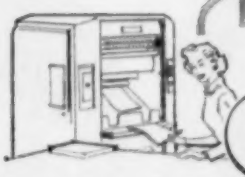
Many models to choose from—to suit every need, any budget! Write us for full particulars.



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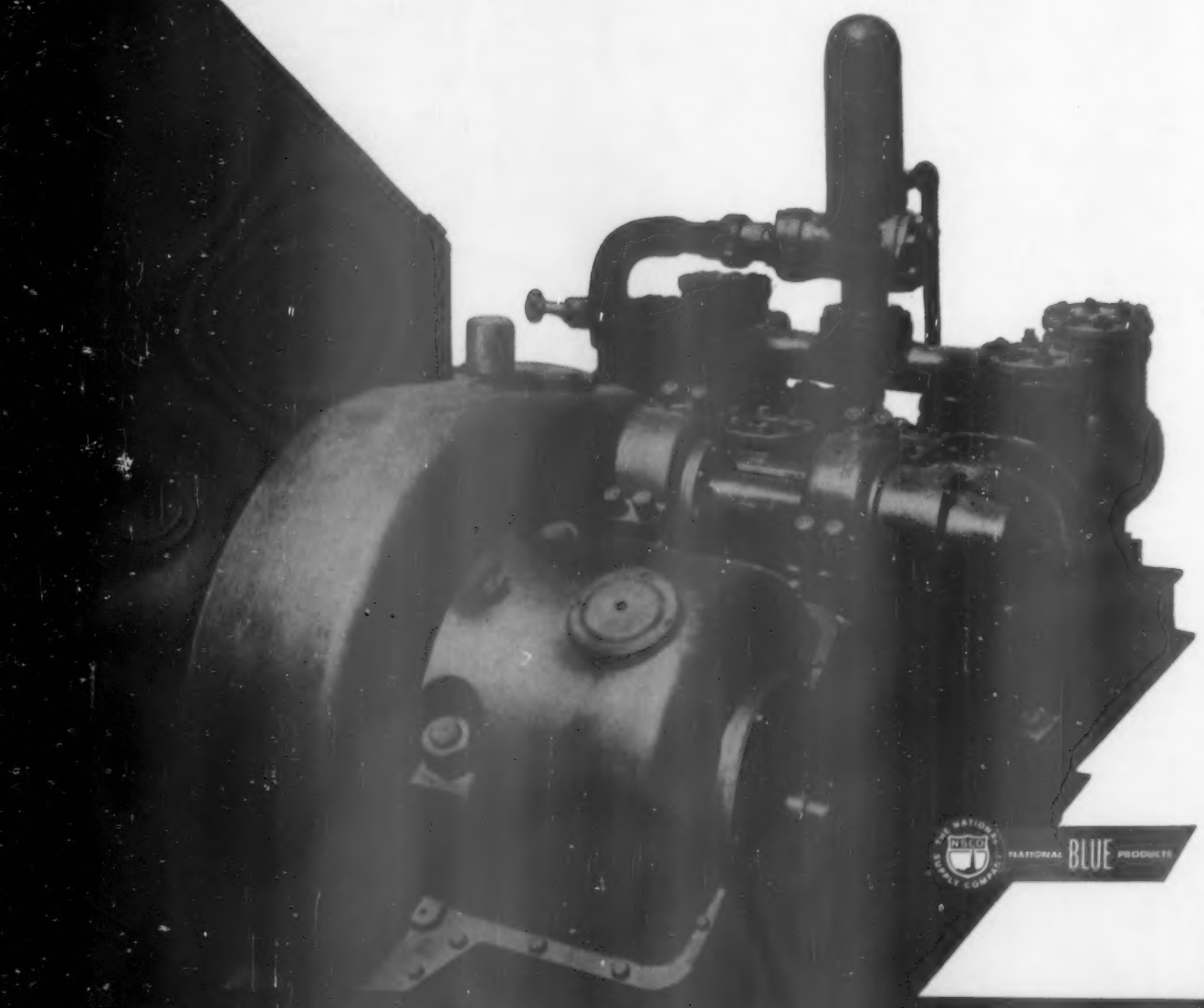
Everything for the Engineer and Draftsman

Slush pump costs when IDEAL® fluid end

OIL MEN KNOW that slush pump maintenance requires more costly man-hours than any other drilling operation—with the possible exception of rig-up and trip time. That's why a continuing *preventive* maintenance program for lower pump operating costs is good business at any man's rig.

FOR MANY YEARS, Ideal Fluid End Parts have been important factors in slush pump preventive maintenance programs throughout the world's oil fields. Here's why:

Ideal Fluid End Parts, like all National Supply oil field equipment, are precision-made under strict manufacturing standards. Field-proven time and time again, these parts give exceptionally long service life under varying slush pump operations, reduce replacement costs and keep pumping efficiency high.



go down parts go in!

IDEAL FLUID END PARTS are available not only for the famous line of Ideal Slush Pumps, but pumps of other makes, too. You'll find them specially-packaged to insure factory-checked precision when you install them. Look for their bright blue and yellow label of quality today . . . Ideal Fluid End Parts are stocked by National Supply Stores in the United States and Canada, and are obtainable abroad through the Export Division of National Supply.

RODS—Metallurgical control insures maximum resistance to abrasion, corrosion and wear.

PISTONS—Molding of rubber to metal core creates positive seal which prevents pressure loss.

VALVES & SEATS—Maximum opening for fluid flow assures complete filling at high speed.

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First in quality . . . First in supply service in oil country everywhere

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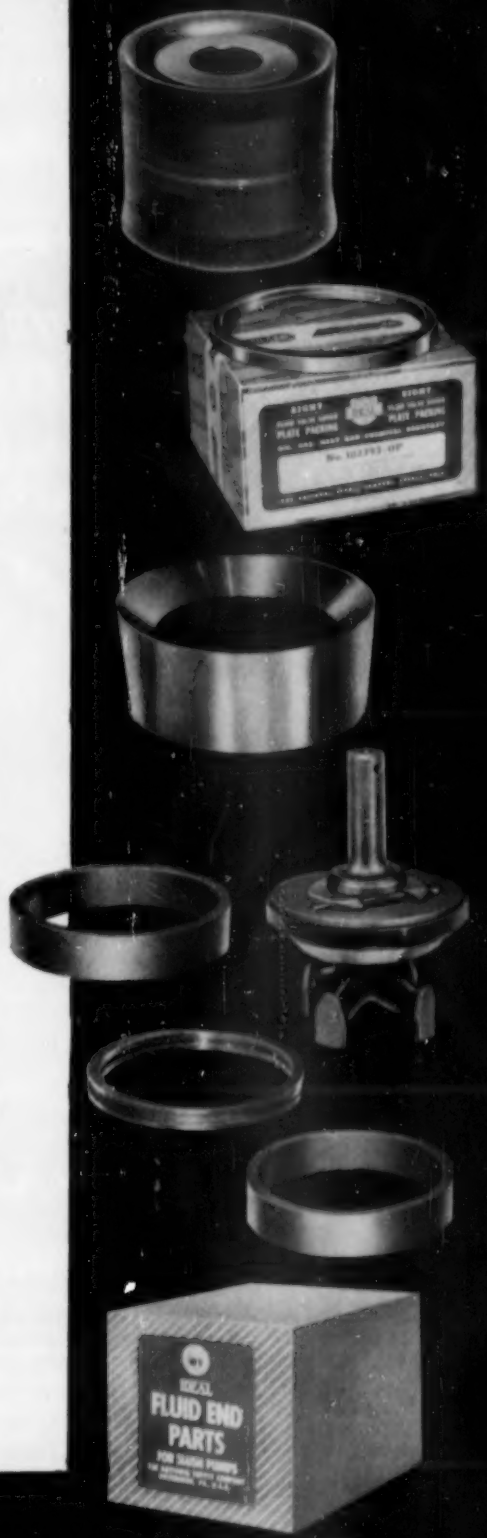
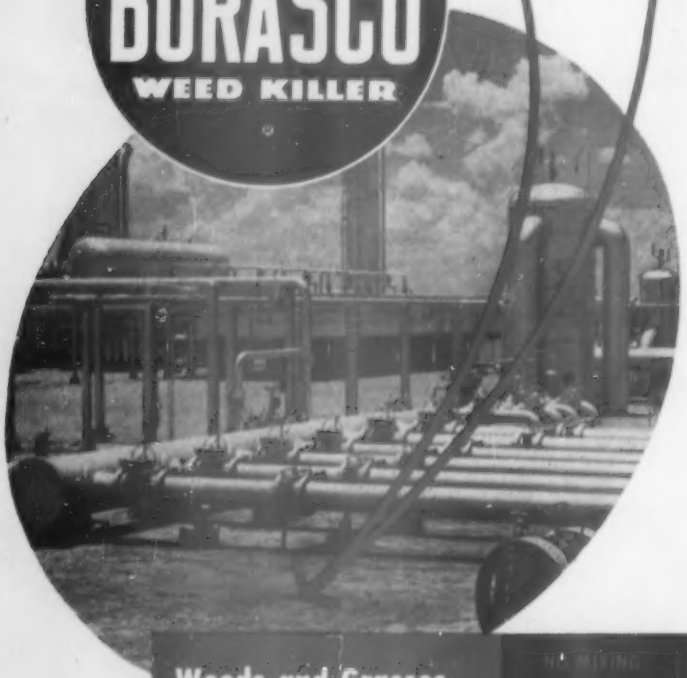
National Oil Field Machinery and Equipment • Spang Steel Pipe • Superior & Atlas Engines



Wherever weeds and grasses are a fire hazard... use...

CONCENTRATED
BORASCU
WEED KILLER



Weeds and Grasses Can't Grow on Ground Treated with Borascu

NO MIXING
NO WATER TO HAUL
NONPOISONOUS
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a single application of Borascu Weed Killer may keep an area cleared for 1 or 2 years!

You won't know how easy it is to cut your "grassing" maintenance costs until you try Borascu! Then you may find, as others have, that your costs will tumble as much as 80%! That's because one speedy application of low-cost Borascu destroys vegetation and prevents its return for many months afterwards... with safety. Write today for literature and where to buy.

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now, this high level of capital expenditure will continue through 1954 and 1955. . . .

"These facts, better than any words, demonstrate our confidence in the future of Shell, the oil industry, and the nation as a whole."

H. S. M. Burns, president of Shell Oil Co., writing in Shell News.

Forget About Recession

"We cannot catalogue all growth-type industries but we must keep in mind that each year we must feed, clothe, and educate an additional 2,700,000 people. This is a basic growth that all industry and farming must recognize.

"For these reasons, the oil industry is building to the future with the same conviction and optimism as millions of fathers and mothers who are bringing into existence approximately 3,700,000 babies per year. What do you say—let's all forget about recession and keep on building!"

John W. Boatwright, general manager of distribution economics department, Standard Oil Co. (Ind.), in an address before the Huron, S. D., Rotary Club.

Oil in the Atomic Age

"No one can begin to guess what roles atomic energy, solar energy, the heat pump, and devices yet to be invented will play in the next few decades. But we are confident that petroleum products, because of their flexibility, will continue to play a major role in meeting the fuel and power requirements of American industry and other consumers."

Augustus C. Long, president of The Texas Co., in a stockholders meeting.

Long Gambles Needed

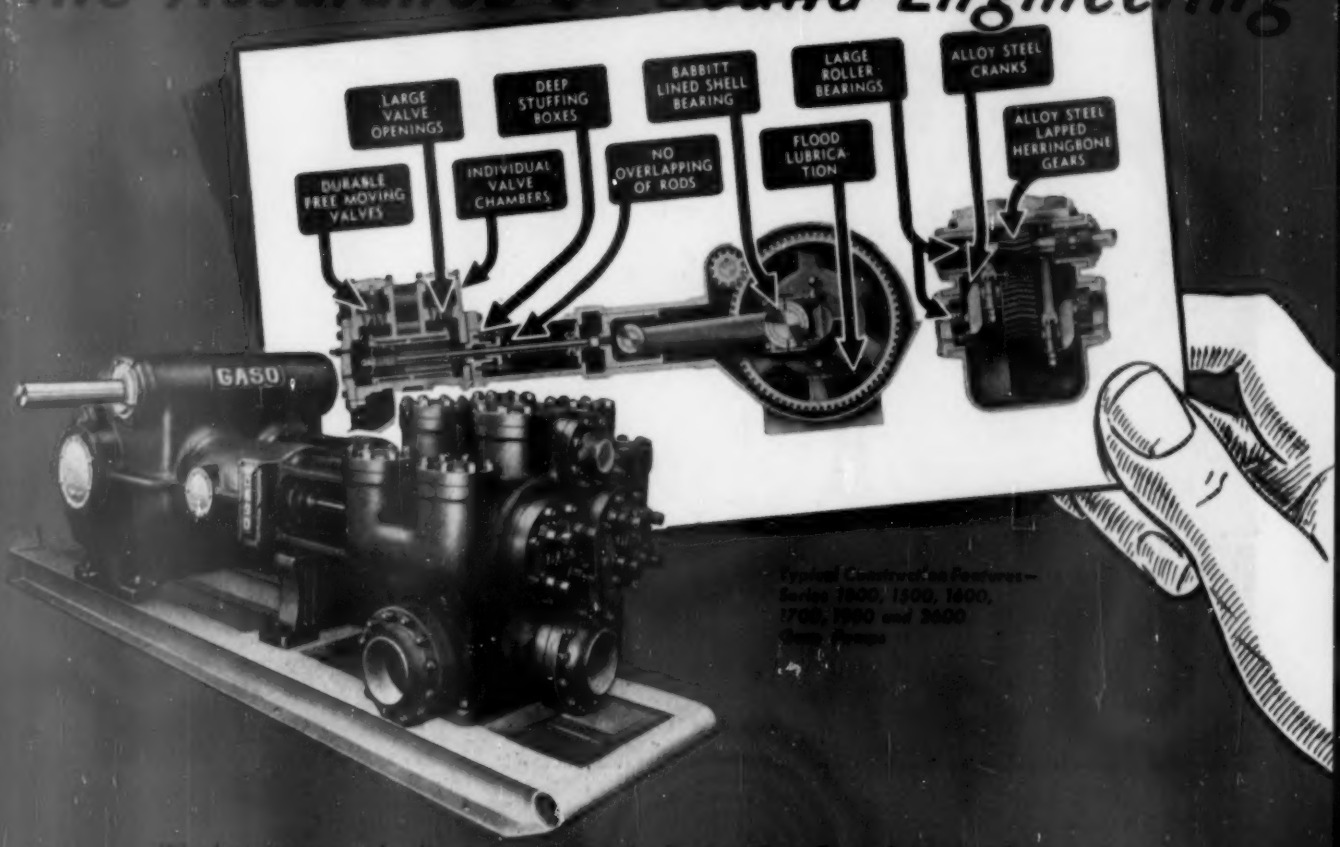
"Under present tax laws, the unfortunate fact is that the number of people who can afford to invest in new and risky ventures is dwindling continually. . . . The odds are great and the time required to bring new enterprises to profitable life is often discouragingly long. . . .

"If we are to find sources of risk capital, we must get it from those who can afford to lose. Yet those who can afford to lose are those on whom our personal income taxes fall most heavily.

"I dislike seeing a tax situation that reduces the possibility of risk and innovation by the small company or by the Thomas Edisons and the Henry Fords of the present time. These small enterprises must look for their capital primarily to the individual investor willing to take a long gamble. They cannot

BACK OF EVERY GASO PUMP

the Assurance of Sound Engineering



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Why have so many pipe line companies standardized on Gaso Pumps? Because Gaso engineering, developed and refined through nearly 40 years of specialization, gives pipe line men exactly what they look for in pumping equipment—trouble-free, capacity performance for periods of time that extend far beyond the life expectancy of ordinary mechanical equipment.

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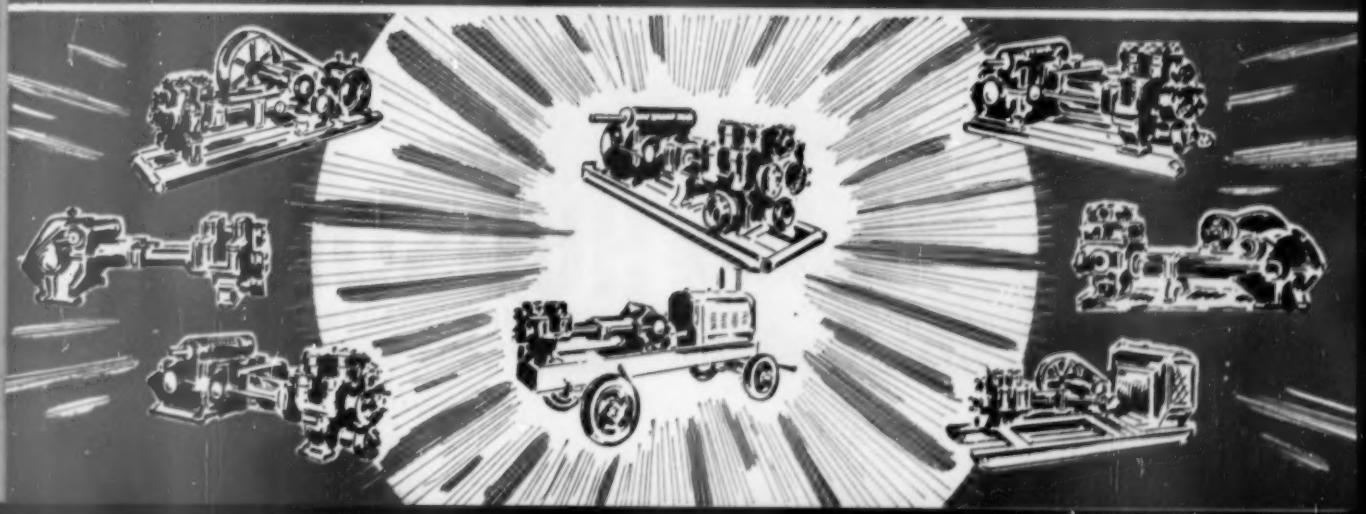
NORTEX ENGINE & EQUIPMENT CO., Wichita Falls, Texas

GASO PUMPS

for every oil industry need



The NEW *Ambrose Gasoline Plant*

at Blackwell, Oklahoma Processes Gas From the Cross Country Pipe Line of Cities Service Gas Company

Through the operation of this plant, designed to produce daily over 4500 barrels of fractionated liquid products from pipe line gas, another completely satisfied plant owner, **CITIES-BLACKWELL CORPORATION,** is added to the long list of oil and gas companies entrusting such multi-million dollar projects to *HUDSON*, experienced in 20 years of designing and building gas processing plants.

The HUDSON organization, qualified by years of experience in the successful design, construction and operation of major oil and gas processing plants, offers its specialized services for projects in any part of the world.

HUDSON
ENGINEERING CORPORATION
FAIRVIEW STATION • HOUSTON, TEXAS

look with confidence to established financial institutions."

Crawford H. Greenewalt, president of Du Pont Co., in an address before the Detroit Economics Club.

From Seventeenth to Seventh

"The development of the crude-oil resources of western Canada continued to be one of the more spectacular activities of 1953. Canadian production of crude oil jumped almost 33 per cent over 1952 to a new high of nearly 81 million barrels. This compared to an increase of 3 per cent for the United States and less than 6 per cent for the entire world. Since 1947, Canada has risen among the oil producing nations of the world from seventeenth to seventh place. . . .

"While there has been considerable discussion as to business conditions in 1954, every indication gives me reason to believe that 1954 will be a year of continued growth for Canada. I anticipate that production and consumption of petroleum will increase, and while competition will undoubtedly be keener, this is a healthy sign, and I am confident that your company will play its full part in the expanded market that lies ahead."

Ole Berg, Jr., president of British American Oil Co., Ltd., at the annual shareholders' meeting.

Royalty Record Questioned

Sir:

"I read the article on page 105 of the April 12 issue of The Oil and Gas Journal and the heading 'Bid Sets Record,' whereby Humble offered 90.5 per cent of all gross oil production for a lease in Anderson and Cherokee counties, and in which your opinion was that that was the highest price ever paid for a lease.

"I wish to call your attention to the fact that about 4 years ago the Union Oil Co. of California secured a lease from the city of Long Beach in the Harbor district for which they will pay the city of Long Beach 95 per cent of all oil gross production. I am not positive that it was the Union Oil, but I do know that the city of Long Beach received 95 per cent, and to knowledge that is the record price ever paid."

N. Spatter
Aztec, N. M.

CALENDAR

MAY

4-7 American Welding Society, national spring meeting, Hotel Statler, Buffalo, N. Y.

6-7 American Petroleum Institute, Division of Production, Pacific Coast district

A Controlled Fire Hazard

CATALYTIC CRACKING UNITS

FRACTIONATION SECTIONS

PUMPING STATIONS

Count 'em — seven propane storage tanks — a potential disaster area for most petroleum properties. Not so at this large refinery though. "Automatic" FIRE-FOG is ready at all times to detect and extinguish the smallest blaze before it becomes a large one — before it shuts down operations, damages equipment, reduces profits.

Many installations of ENGINEERED "Automatic" FIRE PROTECTION have been made in refinery and petro chemical properties throughout the Western Hemisphere and the record speaks for itself: "Complete control of fire within protected areas — in seconds!"

If you're the one responsible for plant safety and continuity of production, we'd suggest an early review of your fire hazard safeguards. Then, whether your needs call for protection by means of "Automatic" Sprinklers, water spray, chemical or mechanical foam, carbon dioxide, or dry powder, we'll gladly provide, at no cost to you, preliminary engineering service. Through this you'll be able to evaluate the economic and adaptability features of each method of protection for your own risk.

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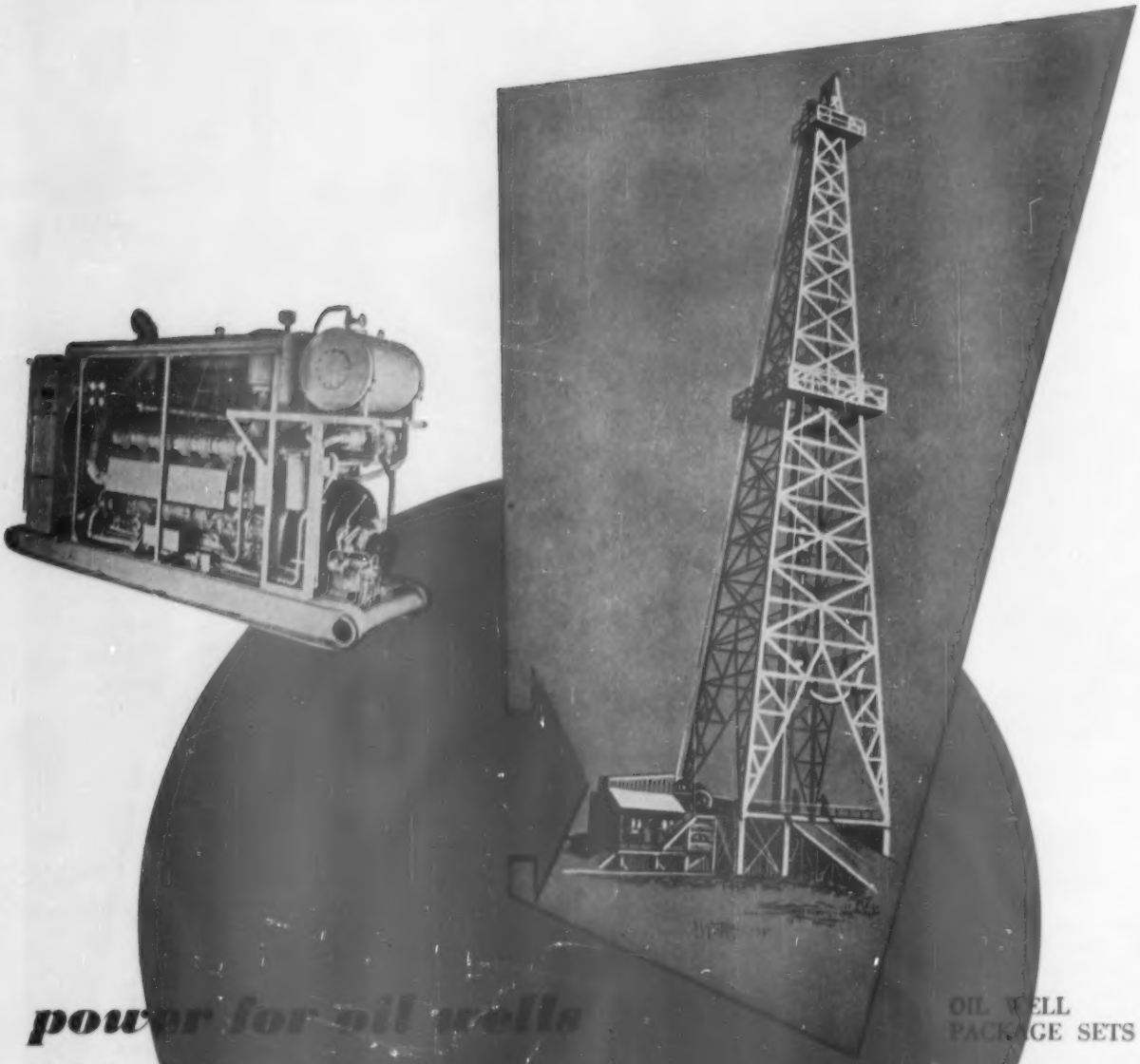

power for oil wells

OIL WELL
PACKAGE SETS

Paxman Diesel [illegible] provide power for sinking oil wells in many parts of the world. The Paxman "Package" set from the [illegible] class, has a 12 cylinder [illegible] and is rated to develop 40[illegible] self-contained unit which, [illegible] be handled on a [illegible]

PAXMAN

diesel engines for oil well drilling

DAVEY, PAXMAN & COMPANY LIMITED, COLCHESTER (ASSOCIATED WITH RUSTON & HORNSBY LTD., LINCOLN)

meeting, Statler Hotel, Los Angeles.

9-12 **Liquefied Petroleum Gas Association, annual convention and trade show, Conrad Hilton Hotel, Chicago.**

10-12 Ninth annual Purdue Industrial Waste conference, Purdue Memorial Union, Lafayette, Ind.

10-12 American Petroleum Institute, Division of Transportation, Products Pipe Line Conference, Warwick Hotel, Philadelphia.

10-13 American Petroleum Institute, Division of Refining, midyear meeting, Rice Hotel, Houston.

12-13 Pacific Coast Gas Association, gas supply and transmission conference, Mark Hopkins Hotel, San Francisco.

14-15 Interstate Oil Compact Commission, General Oglethorpe Hotel, Savannah, Ga.

16-19 **American Institute of Chemical Engineers, Springfield, Mass.**

17-19 American Petroleum Institute, Division of Marketing, midyear meeting, Cosmopolitan Hotel, Denver.

20-21 Kentucky Oil and Gas Association annual meeting, Lafayette Hotel, Lexington, Ky.

20-23 Mississippi Geological Society, eleventh field trip, Nashville, Tenn.

24-26 American Gas Association, production and chemical conference, William Penn Hotel, Pittsburgh.

27-28 Natural Gas and Petroleum Association of Canada, Prince Albert Hotel Windsor, Ont., Canada.

31-June 5 American Petroleum Institute, Division of Production, midyear committee conference, St. Francis Hotel, San Francisco.

JUNE

2-4 Southern Gas Association, short course in gas technology, Texas College of Arts and Industries, Kingsville, Tex.

3-4 Pennsylvania Grade Crude Oil Association, thirty-first annual meeting, Hotel William Penn, Pittsburgh.

6-11 Society of Automotive Engineers, summer meeting, Ambassador and Ritz-Carlton Hotels, Atlantic City, N. J.

13-18 **American Society for Testing Materials, annual meeting and exhibit, Sherman and Morrison Hotels, Chicago.**

14-17 Twenty-sixth annual confrence and exhibit, Oil and Gas Division of the American Society of Mechanical Engineers, Hotel Muehlebach, Kansas City.

17-19 American Petroleum Institute, Division of Production, eastern district meeting, Greenbrier Hotel, White Sulphur Springs, W. Va.

17-19 National Oil Scouts and Landmen's Association, annual meeting, New Orleans.

20-24 Canadian Gas Association, Banff Springs Hotel, Banff, Alta., Canada.

20

July 4 Seventh annual Conferences on Personnel Administration and Managerial Development, Industrial Relations Section of the California Institute of Technology, California Institute of Technology, Pasadena, Calif.

21-25 Gordon Research conferences, conference on petroleum, Colby Junior College, New London, N. H.

24-25 Western Petroleum Refiners Association, regional meeting, Leonard refineries auditorium, Alma, Mich.

27

July 1 Petroleum Equipment Suppliers Association, nineteenth annual meeting, Manoir Richelieu, Murray Bay, Que., Canada.

JULY

15 Southern Gas Association, conference on radio communications for pipelines, Adolphus Hotel, Dallas.

16 Southern Gas Association, dispatchers' conference, Adolphus Hotel, Dallas.

29-31 Wyoming Geological Association, ninth annual field conference, Casper, Wyo.

AUGUST

13 Southern Gas Association, conferences on pipeline operations and pipeline engineering, Rice Hotel, Houston.

16-18 Society of Automotive Engineers, West Coast annual meeting, Statler Hotel, Los Angeles.

20 Southern Gas Association, conferences on natural-gas gathering and natural-gas processing, Captain Shreve Hotel, Shreveport.

23-25 Fourteenth annual Appalachian Gas Measurement Short Course, West Virginia University, Morgantown, W. Va.

26-28 (tentative) Intermountain Association of Petroleum Geologists, fifth annual field conference, beginning at Price, Utah.

SEPTEMBER

7-9 Association of Desk and Derrick Clubs of North America, annual convention, Banff Springs Hotel, Banff, Alta.

8-10 Pacific Coast Gas Association, sixty-first annual meeting, Vancouver Hotel, Vancouver, B. C.

9-11 Interstate Oil Compact Commission, Omaha, Neb.

10 Southern Gas Association, conference

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A FULL PIPE OPENING HORIZONTAL SWING CHECK VALVE
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Pressures: 125# WP to 1800# WP
Ends: Flanges, Screwed, weld
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● Here is the *safe*, compact hose nozzle for dispensing LP gas from bulk delivery trucks and stationary dispensing units. Check these features—never before available in *any* hose nozzle or valve approved for LP gas service by Underwriters' Laboratories—

- Standard one-inch connection can be adapted to fit all types of tank fittings.
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- Resilient synthetic rubber loading valve seat . . . still bubble-tight after more than 1,000,000 test cycles!
- No packing adjustment necessary with O-ring seals.
- Bleeds only 3.2 cubic inches of product after delivery, when equipped with short adapter.
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Write today for full data and prices on this new hose nozzle!

SEE THIS HOSE NOZZLE IN BOOTHS 182 and 183, National Liquid Petroleum Gas Association Convention, Conrad Hilton Hotel, Chicago, May 9th through May 12th.

Okadee COMPANY

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on compressor-station operation, Jung Hotel, New Orleans.

12-16 American Institute of Chemical Engineers, Colorado Hotel, Glenwood Springs, Colo.

13-14 Independent Natural Gas Association of America, annual meeting, Roosevelt Hotel, New Orleans.

15-17 National Petroleum Association, fifty-second annual meeting, Traymore Hotel, Atlantic City, N. J.

16-17 Mid-Continent Oil and Gas Association, Louisiana-Arkansas division, annual meeting, Roosevelt Hotel, New Orleans.

23-24 Western Petroleum Refiners Association, regional meeting, Henning Hotel, Casper, Wyo.

27-29 Electrical Conference for Petroleum Industry, American Institute of Electrical Engineers, Mayo Hotel, Tulsa.

27-30 Ninth Annual Petroleum Mechanical Engineering Conference, petroleum division of the American Society of Mechanical Engineers, Statler Hotel, Los Angeles.

30 Southern Gas Assoication, conference on transmission management, Shamrock Hotel, Houston.

OCTOBER

1 Southern Gas Association, conference on gas pipeline rights-of-way, Rice Hotel, Houston.

4-6 Texas Mid-Continent Oil and Gas Association, annual meeting, Plaza Hotel, San Antonio, Tex.

4-6 Petroleum Electric Power Association, twenty-sixth anniversary meeting, Jung Hotel, New Orleans.

6-8 Eighteenth Technical Conference on Petroleum Production, Pennsylvania State University, State College, Pa.

7-8 California Natural Gasoline Association, twenty-ninth annual fall meeting, Ambassador Hotel, Los Angeles.

7-8 American Institute of Mining and Mettallurgical Engineers, Pacific Petroleum chapter, fall meeting, Biltmore Hotel, Los Angeles.

11-13 American Gas Association, annual convention, Atlantic City, N. J.

11-13 American Association of Oilwell Drilling Contractors, annual meeting, Biltmore Hotel, Los Angeles.

12-15 Eighth National Chemical Exposition, Chicago Coliseum, Chicago.

14-17 Permian Basin Oil Show, Odessa, Tex.

17-20 American Institute of Mining and Metallurgical Engineers, petroleum division, fall meeting, Plaza Hotel, San Antonio.

24-26 Independent Petroleum Association of America, annual membership meeting, Mayo Hotel, Tulsa.

26-27 Society of Automotive Engineers, national diesel engine meeting, Statler Hotel, Cleveland.

NOVEMBER

4-5 Society of Automotive Engineers, national fuels and lubricants meeting, Mayo Hotel, Tulsa.

5 Southern Gas Association, conference on field production of natural gas, Herring Hotel, Amarillo.

8-11 American Petroleum Institute, thirty-fourth annual meeting, Conrad Hilton Hotel and Palmer House, Chicago.

28-Dec. 3 American Society of Mechanical Engineers, Statler Hotel, New York.

DECEMBER

2-4 Interstate Oil Compact Commission, winter meeting, Drake Hotel, Chicago.

But the INTERNATIONAL word for water is LAYNE

Conquering all barriers of space, language and time, Layne service and Layne equipment is known and respected wherever man has need for water. And that need is universal.

Long years ago, a man named Layne with a one man muscle power rig drilled a hole in arid land—then known as Dakota Territory—and the first Layne well went into service. Through the years between, an idea has grown into a service that knows no boundaries and Layne & Bowler, Inc. are today the world's largest developers of ground water resources.

The "know how" that has accumulated in that nearly three quarters of a century is today available to industry, agriculture and municipality. Focused on specific problems through trained engineers and technicians, it is a unique service that includes exploration . . . drilling . . . modernization . . . maintenance and installation of Layne equipment.

From the largest industrial and municipal projects to the small farmer concerned with an irrigation system, that knowledge is available without cost or obligation.

On any problem that relates to water it is wise to first consult Layne & Bowler, Inc. either directly or through an associated Layne company.

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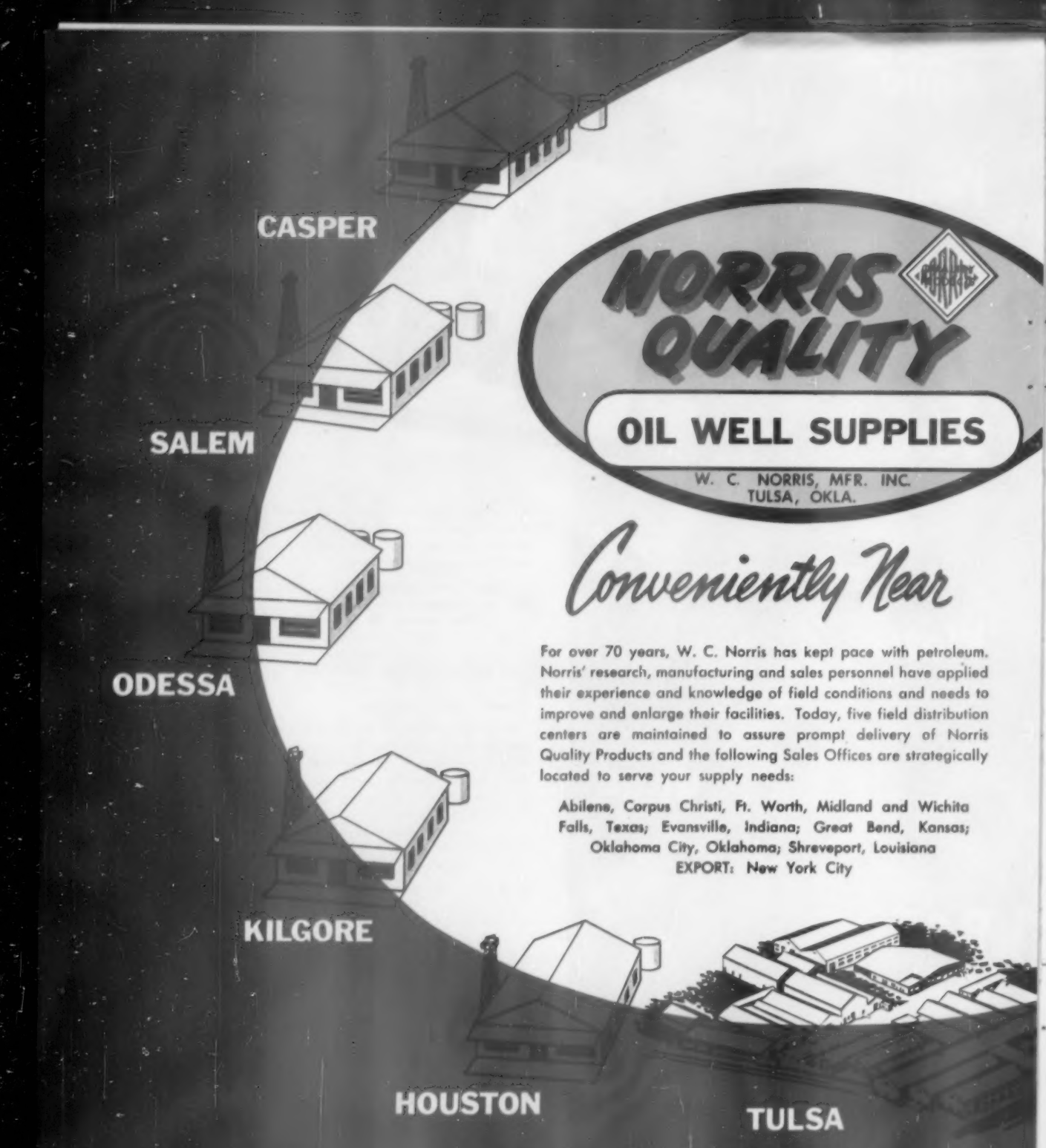

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For over 70 years, W. C. Norris has kept pace with petroleum. Norris' research, manufacturing and sales personnel have applied their experience and knowledge of field conditions and needs to improve and enlarge their facilities. Today, five field distribution centers are maintained to assure prompt delivery of Norris Quality Products and the following Sales Offices are strategically located to serve your supply needs:

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THE OIL AND GAS

JOURNAL

TULSA, OKLAHOMA

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●

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JOURNALLY Speaking

Beaver Business

GIRLS, how would you like a new fur coat or stole, made from modish nutria? Some day you may get one from an oil refinery. At least one oil company is in the business. Well, not directly in the business, but sort of.

Down at its Sweeny refinery on the Texas Gulf Coast, Phillips Petroleum Co. gets water from a lake. The lake is getting choked with vegetation. Chemical weed killers might contaminate the water. So Phillips went into the nutria business.

Nutria? Yeah, nutria—you know—the fur of coypu or South American beavers. Look like North American beavers except that they don't have flat tails and don't build dams. Also, instead of chewing down trees, they eat water vegetation. Phillips imported a colony of 'em and turned them loose in the lake, where they went right to work doing what they were supposed to do like true eager beavers.

Quite incidentally, nutria makes a coat that will turn the woman next door green with envy. So, girls, if your company is having trouble with water vegetation, just drop a note in the suggestion box and you may win a nutria coat as a prize.

Family Party

LAST week, by special invitation, we were a guest at a family party given by the "Old Timers' Club" of a well-known oil company. Everybody there (except us and the accordion player) had worked for the company at least 25 years and some as long as 40 years. Though an outsider, we enjoyed it immensely, and it set us to thinking about the human side of the oil industry.

Here was a group of several hundred people who had been working together and depending on each other for a living for a quarter-century and more. They had got to know each other pretty well, even though it was a big, diversified company. Here they were all equal—pumpers, stillmen, pipeline walkers, engineers, scientists, stenographers, and top-management brass. They renewed acquaintanceships over the canapes, recalled old times over the T-bone steaks, and vociferously welcomed the new initiates receiving their diamond-studded 25-year pins. They seemed to be one big happy family.

Functions like that are being held throughout the year all over the country by employes of oil companies large and small. We don't know whether or not the custom is widespread in other industries, but it's quite an institution in the oil business. It shows that oil is a pretty good way of life when so many people, with such diversified skills and occupations, remain with the same outfit for so many years and fraternize in such an informal manner.

Extra Specials

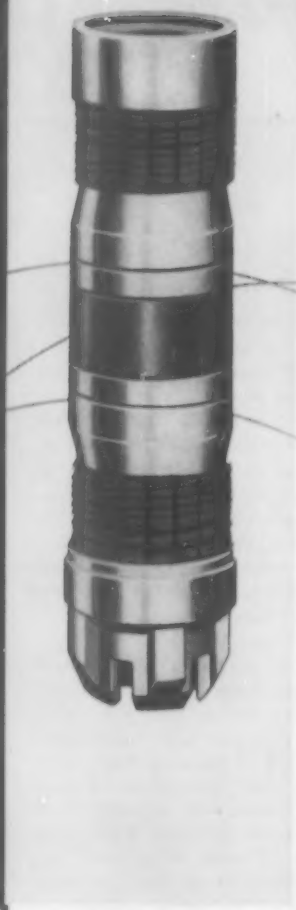
NO doubt some copies of our favorite oil publication do get damaged in transit by forces beyond our control, but it beats all how most of the requests for extra copies to replace damaged ones relate to our special issues.

Our circulation manager, a suspicious cuss if there ever was one, has evolved the uncharitable theory that some people are just trying to chisel a second copy of these valuable specials by claiming that theirs got lost or damaged in the mails. Tsk, tsk. So he usually replies that we are fresh out of extra specials—which we usually are.

But recently a subscriber wrote that after waiting a whole year for one of our special issues, only half of it arrived. To substantiate his integrity, he enclosed the damaged wrapper, on which the post office had written "Run over by train." Of course this might have been just a new dodge but it looked like a legitimate excuse. So he got his extra special.

—Henry D. Ralph.

BAKER CAST IRON
TYPE BRIDGE PLUG



BAKER MAGNESIUM ALLOY
TYPE BRIDGE PLUG

PARTNERS

in performance

Either the Baker CAST IRON Bridge Plug, or the MAGNESIUM ALLOY Type will set positively, and prevent movement of fluid or gas either up or down the well, under any pressure safe for your casing.

For temporary installations, with no deleterious fluids present, the MAGNESIUM ALLOY Type is recommended. If the installation is permanent, or if harmful well fluids are encountered, use the CAST IRON Type.

FOR WIRE LINE SETTING
contact any of these
leading service organizations:

THE FORD ALEXANDER CORPORATION
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RAM-GUNS, INC.
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WELEX JET SERVICES, INC.
THE WESTERN COMPANY

SET ON WIRE LINE

Although the Baker Bridge Plug can be set on tubing or drill pipe, *wire line setting* not only saves wear and tear on tubular goods, but the saving in time in deeper wells is an important advantage. Just call any of the wire line service organizations listed at left.

DRILL OUT QUICKLY

Baker Bridge Plugs are *short*, and have been designed with "drillability" in mind. The CAST IRON Type breaks up and drills out quickly. And the MAGNESIUM ALLOY Type requires the absolute minimum of drilling-out time.

DEPENDABLE

Baker Bridge Plugs maintain a perfect pack-off against upward or downward movement of fluid or gas under any pressure that is safe for the casing and well equipment.

BAKER BRIDGE PLUG

Gas is heading toward an economic balance

CHANGES are beginning to appear in the nature of the natural-gas-transmission industry. The laws of supply and demand are catching up with it.

There is an early end in sight to the spectacular postwar growth period with its breathless rush to string new lines from apparently unlimited supplies of cheap gas to seemingly insatiable rich markets.

Within a couple of years it is probable that every major consuming region in the United States will be served with natural gas and every important producing region will have at least one pipeline outlet.

The rapid expansion has bid up the price of gas so that reserves for a new line now cost four or five times as much as they did 10 years ago. And the price at the delivery ends of long lines is meeting some resistance in the form of competition from other fuels.

GAS IS STILL CHEAP in most producing areas—too cheap on the basis of its heat and chemical content in comparison with other fuels, even though the average field price has been rising rapidly and will continue to rise.

But some of the most recent dedications of big reserves to pipeline use have been at prices which approach the economic ceiling. For when this gas is piped 1,000 miles or more to an industrial area it must sell at prices which may be higher, on a heat basis, than coal or oil.

With bulk industrial markets thus getting harder to capture and hold, future growth will be largely in residential and commercial uses which will support higher prices because of gas' premium qualities.

BUT THESE FACTORS THREATENING to slow the rapid growth of demand and prices should not alarm producers. The recent very high purchase contracts probably yield the producers as much as oil at the wells, based on cost of production, so that an economic balance seems probable at the producing end as well as at the consuming end.

The prospect that gas will command an economic price is encouraging the discovery and development of new reserves and the elimination of waste in the fields, thus assuring a continuation of supply. At the same time, the realization that competition will put a ceiling on gas prices is assurance to consumers that this essential commodity will not be priced beyond its worth—or their reach.

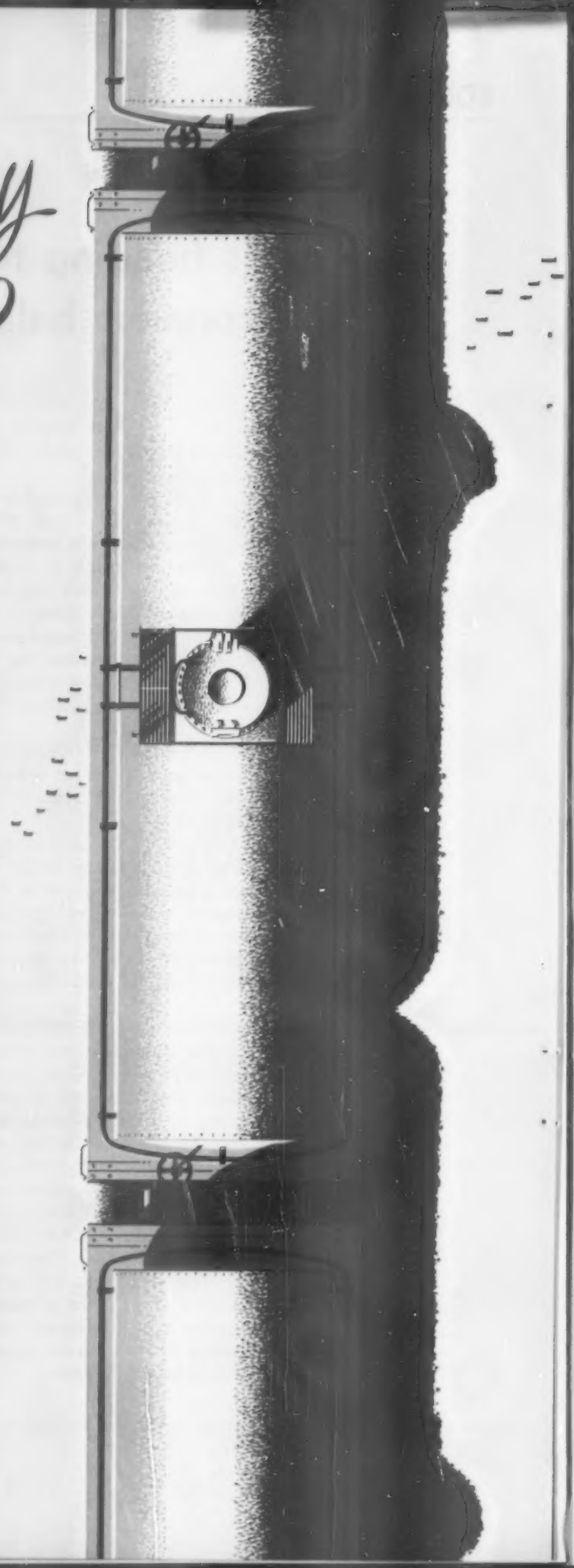
Just one thing will prevent reaching this economic and competitive balance. That is the prospect—currently a little less imminent than a few months ago—of federal regulation holding gas at arbitrarily low field prices. If that threat passes, a few years will see natural gas a stable and balanced industry.

Which way does a train go?

ANCHOR trains go both ways, picking up your surplus stocks of petroleum products or supplying your needs directly to your door. Anchor can serve you as your ex-officio marketing department, relieving you of duties which are our specialty.

Fleets of Anchor tank cars are at your disposal. Our marketing men have years of experience buying and selling petroleum products. You are assured of our best service because we want to get and keep your business. Call us, 2-7261, Tulsa.

Anchor buys and sells: Butane, Propane, Natural Gasoline, Diesel Oil, Fuel Oil, Naphtha, Kerosene and other Petroleum Products.



"Merchants of Petroleum Products"

ANCHOR
PETROLEUM COMPANY
TULSA

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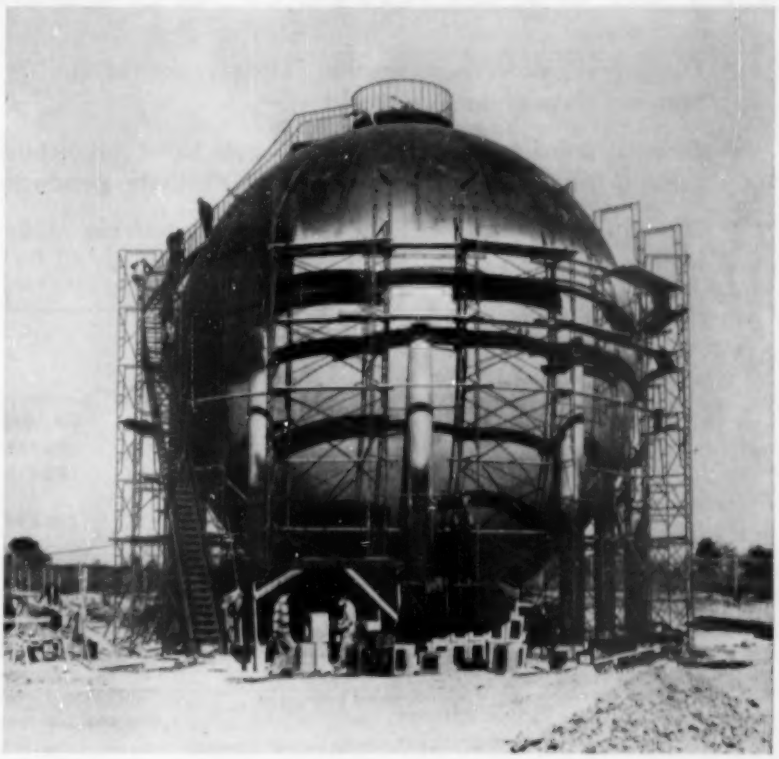
THIS WEEK . . . . . IN THE NEWS

PRODUCTION — Northeastern Oklahoma and eastern Kansas are witnessing their biggest oil boom in 30 years. . . . Most of the work being done by independents who have shallow, erratic Pennsylvanian sands as their principal targets. . . . Formation fracturing is the key to the upswing in activity. . . . ¶Pipeline proration is adopted by two Oklahoma companies despite Oklahoma Corporation Commission ruling that prohibits such action. . . . Other companies may follow suit. . . . Lack of adequate markets blamed for cuts in crude purchases. . . . ¶Independent Petroleum Association of America's committee on productive capacity declares United States was capable of producing 8,699,500 bbl. daily on January 1. . . . This capacity is expected to jump to 9,105,000 bbl. daily by January 1955.

FIELDS—Magnolia seeks approval of 16,000-acre water flood in Pegasus field. . . . Project would probably be deepest flood ever attempted, would recover perhaps 200,000,000 bbl. of additional oil. . . . ¶North Dakota grants 80-acre spacing for three fields, keeps 40-acre spacing in a fourth. . . . ¶Southern Union Gas Co. extends Pictured Cliffs gas production 12 miles eastward with important strike in New Mexico's Rio Arriba County. . . .



SYNTHETIC ANHYDROUS AMMONIA continues as the greatest "growth" petrochemical of all. This week, Allied Chemical & Dye Corp.'s nitrogen division announced a 50,000-ton-per-year addition to its Hopewell, Va., facilities. The next major plant to come on stream will be the 90,000-ton-per-year Memphis operation which Grace Chemical Co. will complete this summer. This Hortonsphere shown nearing completion at the $20,000,000 Memphis plant will store ammonia which will find an outlet in the agricultural market surrounding that southern city.

REFINING—Catalytic hydrogenation with a "light touch" is acquiring more followers among refiners. . . . This new look, less spectacular but more attractive commercially than older extreme high-pressure operations. . . . Forty such units are now in operation, under construction or planned. . . . ¶Union Oil Co. plans a 450-bbl. Unifiner at its Cut Bank, Mont., refinery. . . . ¶Main towers and vessels for Shell Oil Co.'s 4,500-bbl. Platformer at its Martinez refinery near San Francisco are already in place. . . . Completion is expected by mid-June. . . .

SUPPLY AND DEMAND—Both total and domestic petroleum demands are scheduled to increase this year according to Independent Petroleum Association of America figures. . . . I.P.A.A. says total demand during year will average 8,236,000 bbl. daily. . . . Domestic demand expected to increase 3.8 per cent this year to 7,918,000 bbl. daily. . . . Crude and products exports expected to drop 20.7 per cent.

PIPELINE—Coal-producing states prepared to fight government spending for Gulf Coast-East Coast crude line. . . . Opponents charge the proposed big-inch line is a "fantastic scheme." . . . ¶FPC approves purchase of Interstate Natural Gas Co.'s pipeline facilities by Olin Interstate Corp. for $40,000,000. . . . Sale approval made on condition that Olin does not assume $32,000,000 mortgage. . . . ¶Work scheduled to start immediately on Texas Eastern Penn-Jersey Transmission Corp.'s 265-mile, 24-in. line from Oakford storage field to Lambertville, N. J. . . . ¶Decision still up in the air on whether Minnesota Pipe Line Co. or Sioux Pipeline System will build line to transport crude to refinery proposed by Great Northern in Twin Cities area. . . . Northern has indicated it favors Minnesota's proposed link with Interprovincial-Lakehead system. . . .

GOVERNMENT—Commerce Department urges Congress to adopt "trade-in-and-build" tanker policy advanced last July by Secretary of Commerce. . . . Department report points to strong competition domestic tanker operators get from foreign-flag vessels and predicts it will continue "for some time." . . . ¶Governors of coal-producing states form conference for "crusade" against oil imports. . . . ¶I.P.A.A. passes resolution calling on Congress to pass legislation "to correct" imports situation, but deliberately avoids any specific recommendations. . . .

INTERNATIONAL—Shortage of foreign exchange is causing Japan's oil industry increasing trouble. . . . The government has already imposed heavy curbs on fuel uses, but a move to cut back use of gasoline has been postponed. . . . Independent refining and marketing companies are seeking oil imports through barter agreements. . .

Hydrogenation Success Assured

- **Forty units now in operation, under construction, or planned throughout the world**
- **Several catalytic processes developed to economically desulfurize and otherwise upgrade distillate products**
- **Ultimate goal not reached, but important stride made in that direction**

George Weber

NEW YORK.—The catalytic hydrogenation of petroleum is back in the news. This time it wears a new look which is less spectacular but commercially more attractive than the extreme high-pressure operations of former years.

The type of hydrogenation which is interesting refiners today is a moderate "touch" of hydrogen which can improve many distillate products. Its most important application at present is in desulfurization, but it is also proving useful in improving the characteristics of catalytic reforming and cracking feed stocks, boosting cetane ratings of diesel fuels, deodorizing solvents, and raising viscosity index of lube fractions.

In improving older methods of chemical treating, this technique is contributing measurably to the conservation of petroleum.

The losses in yield, often amounting to 10 per cent or more with chemically treating petroleum stocks, are eliminated in mild catalytic hydrogenation. Product yields in this type of processing are generally on the order of 100 per cent or more since it is a straight hydrogen addition reaction, minimizing the splitting of carbon-to-carbon bonds and producing no appreciable byproducts excepting hydrogen sulfide, ammonia, and water. Further conservation is realized from the extended usage obtained from the gallon of diesel oil or the quart of lubricant.

Field is wide . . . Evidence of a sharply revived interest in this type of processing is the growing list of such operations in refineries of both hemispheres. At the latest count, 9 units were in commercial operation, 14 were under construction, and 17 were licensed or contracted. These units employ eight different processes and have an aggregate capacity for processing about 344,000 bbl. of feed per day. Their versatility and flexibility are well adapted to the realistic requirements of present-day refining, and should promote widespread acceptance of this new refining technique over the next few years.

Situation In Brief . . .

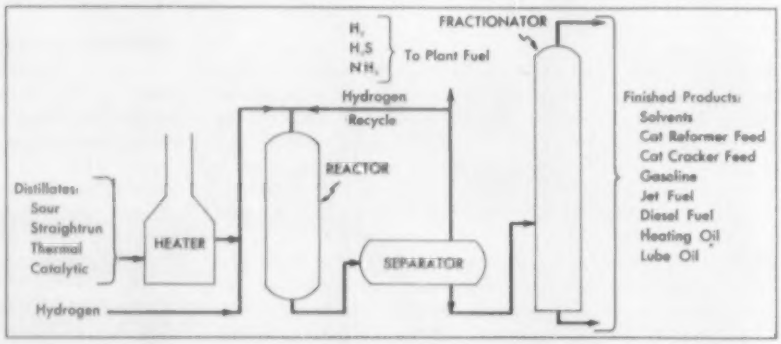
	No. of units	Capacity, bbl./day
Operating	9	33,888
Building	14	104,410
Contracted or planned	17	205,690
Total	40	343,988

The accompanying table lists the hydrogenation units which are known to be operating or planned in refineries around the world. These units are restricted to the type of process which employs hydrogen recycle, and moderate temperatures and pressures.

The moderate touch . . . These modern hydrogenation units are not surrounded by the thick concrete walls with which many refiners have associated this type of operation. In fact, they are difficult to distinguish from other processing facilities in a refinery. For the most part they consist of a heater, reactor, disengager or separator, and fractionator with provisions for recycling hydrogen to the reactor. Since the hydrogenation reaction is exothermic, the reactor effluent gives up heat by exchange with fresh feed, and cooling water.

This type of hydrogenation is the mild variety, which ordinarily requires pressures not in excess of those employed in catalytic reforming. In this, it differs considerably from the severe, high-pressure type of operation which caused a brief flurry in this country before the war, and accounted for much of Germany's gasoline production during World War II. Neither does it resemble the modern type of hydrogenation employed in converting American coal to chemicals and German residual oil to distillates.

These severe operations have proved technically workable, but they are not commercially applicable in this country to the conversion of residual oil to gasoline and middle distillates. The required pressures make them too costly, and the hydrogen requirements exceed the supply available from catalytic reforming alone. In time, perhaps 5 to 10 years hence, this ultimate goal may be reached. Meanwhile, the residual fraction can be most economically converted to higher valued distillates by means of the several conventional techniques now in use—vacuum dis-



BASIC STEPS followed in most hydrorefining processes are depicted by this flow chart. Hydrogen source is high-pressure catalytic reformer tail gas taken "as is" from the reformer without further purification of hydrogen. Recycle hydrogen may be treated for H_2S removal in some units.

Hydrogenation Units Licensed for U. S. and Foreign Refineries

Refining company and plant location—Type feed—	Capacity (bbl. daily)	Status
AUTOFINING (A.I.O.C.)		
Anglo-Iranian Oil Co.:		
Aden—Power kerosine	3,500	Building
National Oil Refineries, Ltd.:		
Llandarcy, Wales—Tractor fuel	3,500	Operating
Scottish Oil, Ltd.:		
Grangemouth, Scotland—Various (experimental)	450	Operating
HYDROFINING (A.I.O.C.)		
Anglo-Iranian Oil Co.:		
Kwinina, Australia—Kerosine, gas oil	5,000	Building
HYDROSULFURIZATION (SHELL)		
"Shell" Refining & Marketing Co., Ltd.:		
Stanlow, England—Gas oil	5,000	Building
Canadian Petrofina, Ltd.:		
Montreal, Canada—Gas oil	3,000	Building
HYDROFINING (S.O.D.)		
Esso Standard Oil Co.:		
Bayonne, N. J.—Wax	2,500	Operating
Linden, N. J.—Heavy thermal naphtha	7,640	Building
Linden, N. J.—Cracked heating oil	19,520	Building
Baton Rouge, La.—Virgin gas oil	26,200	Planned
Baton Rouge, La.—Coker gas oil and naphtha	12,740	Planned
Baltimore, Md.—Light virgin, light coker, and heavy cracked naphtha	12,000	Building
Baltimore, Md.—Heavy virgin naphtha	3,000	Building
Baltimore, Md.—Heavy cracked heating oil	5,000	Building
Everett, Mass.—Heavy cracked naphtha	2,400	Planned
Everett, Mass.—Heavy cracked heating oil	2,250	Planned
Humble Oil & Refining Co.:		
Baytown, Tex.—Heating oil	20,000	Operating
Baytown, Tex.—Lubes	4,850	Planned
Baytown, Tex.—Heavy cracked naphtha	12,000	Planned
Imperial Oil, Ltd.:		
Sarnia, Canada—Lubes and waxes	600	Operating
Edmonton, Canada—Lubes	2,000	Building
Esso Petroleum, Ltd.:		
Fawley, England—Tractor fuel	3,705	Operating
Fawley, England—Solvent naphtha	1,583	Operating
Esso, A. G.:		
Hamburg, Germany—Diesel gas oil	8,450	Planned
Esso Standard, S.A.F.:		
Port Jerome, France—Virgin gas oil	8,450	Planned
UNIFINING (U.O.P.-UNION)		
Tide Water Associated Oil Co.:		
Avon, Calif.—Catalytic reformer feed	10,000	Building
Union Oil Co. of California:		
Oleum, Calif.—Coker naphtha	15,750	Building
United Refining Co.:		
Warren, Pa.—Solvents	750	Operating
Undisclosed (nine units)	128,350	Contracted
HYDROTREATING		
The Texas Co.:		
Wilmington, Calif.—Cracked naphthas	10,000	Building
UNNAMED		
(Husky) Husky Oil Co.:		
Cody, Wyo.—Diesel fuel	800	Operating
(Kellogg) Pure Oil Co.:		
Newark, Ohio—Catalytic reformer feed	3,000	Building

tillation, coking, visbreaking, solvent decarbonizing, and catalytic cracking of heavy distillate stocks.

Hydrorefining will enter into this picture to an important degree by cleaning these converted distillates, either to improve their qualities as finished products or to render them more valuable for further processing. In this latter respect, hydrogen pretreatment of sour thermal naphthas will greatly widen the range of catalytic reforming feed stocks for processes employing platinum catalysts. Nearly 70 per cent of the nation's catalytic reforming capacity now operating or building employs this type of catalyst.

Now it's economic . . . In order to pay out, hydrogenation of any type must be based on an adequate supply of hydrogen at a sufficiently low cost. Hence, the current revival in the technique is an adjunct of the present boom in building catalytic reforming facilities which produce net hydrogen from the conversion of naphthenes to aromatics.

Further improving the economics of hydrogenation is due to the fact that the hydrogen-rich "tail gas" from these reformers is available at or close to the pressures required for most of the mild hydrogenation processes developed to date. Moreover, the hydrocarbons and hydrogen sulfide which may accompany the hydrogen do not seriously affect the hydrogenation reaction. Hence, no purification is required, and the gas from the reformer's recycle stream can be withdrawn directly to the hydrogenation unit.

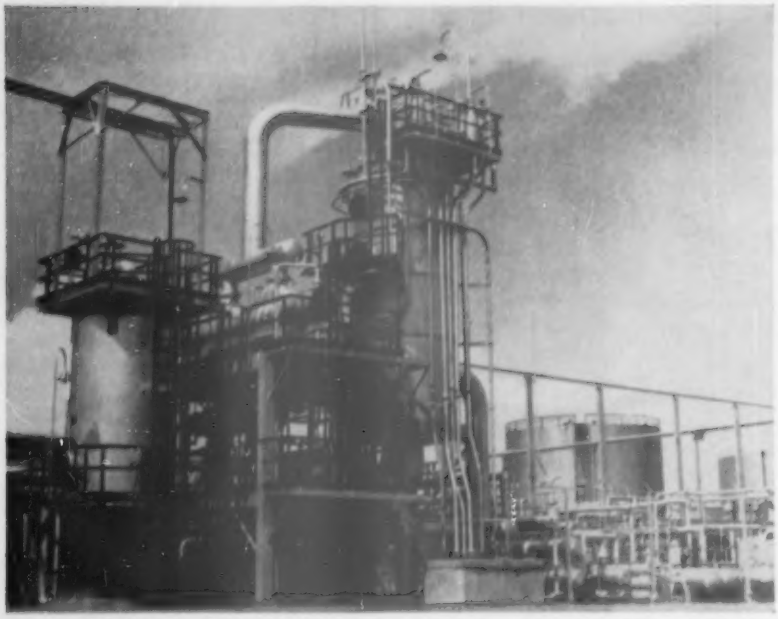
The hydrogen produced in catalytic reforming is sufficient to meet most of the mild hydrogenation needs of these current processes. Refinery balances will vary considerably with the differing content of naphthenes and sulfur in the crude stocks, but in a refinery processing sour crudes a catalytic reformer sized to process the average naphtha fraction will normally produce more than enough hydrogen to desulfurize all of the refinery's products.

For example, a reformer feed stock containing 30 per cent naphthenes will produce about 950 cu. ft. of hydrogen per barrel of feed. On the other hand a diesel fuel distillate containing 2 per cent sulfur can be effectively desulfurized for about 100 to 150 cu. ft. of hydrogen per barrel. The saturation of cracked distillates entails a higher hydrogen consumption. A sour visbreaker distillate can be sweetened and saturated with 300 to 350 cu. ft. per barrel of hydrogen and about 200 cu. ft. per barrel will sweeten and saturate catalytic cycle oil. These requirements are still well within the hydrogen output of a catalytic reformer in a balanced refinery.

Big supply seen . . . Hydrogen aplenty appears to be on the way for this type of operation. In the United States alone, a total of 460,000 bbl. per day in cat reforming capacity is being built this year. Superimposed on the 250,000 bbl. per day in operation at the first of this year, this current building boom will raise the nation's capacity over 700,000 bbl. per day by early 1955.

The projected octane race indicates strongly that refiners are going to use their new cat reformers at or near capacity for the foreseeable future. Assuming a conservative production of 500 cu. ft. per barrel of feed, United States refiners will be producing on the order of 355,000,000 cu. ft. of byproduct hydrogen per day by 1955.

Only when considering the severe hydrogenation of residual fractions does this supply of byproduct hydrogen fall short of needs. The extreme high-pressure hydrogenation of a heavy residual fraction to yield gasoline and diesel fuel requires about 3,000 cu. ft. of hydrogen per barrel of residual feed stock.



THIS HYDROFORMING UNIT has been in operation since the fall of 1953 at the Fawley, England, refinery of Esso Petroleum Co., Ltd. It is used to upgrade 1,580 bbl. daily of solvent naphtha.

These requirements, plus the high-pressure costs involved, are the main deterrents of this type of conversion today.

It is considered possible that the future will bring new sources of hydrogen such as ethylene synthesis, butane dehydrogenation, and other petrochemical processes which might render residual conversion economical in some plants. For the present, however, the supply seems well suited to the requirements for the current, milder operations.

Many cat reforming refiners have been considering uses for their byproduct hydrogen for some time. In most cases, there isn't enough to justify building ammonia or other chemical synthesis plants. But there are exceptions.

The Atlantic Refining Co. recently completed a plant at Philadelphia which will convert catformer hydrogen to 100 tons of synthetic anhydrous ammonia per day. This is the first such plant to be based on refinery hydrogen. It is justified since a brisk market for ammonia exists in the immediate market area. Dow Co. of Canada is understood to be expanding ammonia facilities at Sarnia, Ont., based on hydrogen produced in neighboring catalytic reformers. At Toledo, Sun Oil Co. will sell hydrogen produced in their new Platformer to Republic Steel Co., which will utilize it in the manufacture of powdered iron.

These chemical and outside uses are exceptions. The consensus among refiners seems to favor internal use of hydrogen by an overwhelming margin. The extent of unit building today is only a slight indication of the interest being shown in this development.

Hydrofining . . . The Hydrofining process *(The Oil and Gas Journal, January 25, 1953, page 171)* perfected by Standard Oil Development Co. is being applied in a wide variety of commercial operations by affiliated companies of Standard Oil Co. (N.J.).

Five of these commercial units are in operation in the United States, Canada, and England, and 14 additional installations are either under construction or planned for refineries in five countries. A total of 155,000 bbl. per day in capacity is scheduled for Jersey affiliated plants. According to an announcement made last week, the process is now available to other oil companies under license from S. O. D.

The design and operation of Hydrofining units will vary with the type of feed and the desired degree of treatment. Charge stock is heated in a coil furnace to a temperature ranging from 500° to 800° F. mixed with fresh hydrogen. The heated charge then passes to the fixed-bed reactor which contains a regenerable metal oxide catalyst. Hydrogenation takes place at pressures varying from 50 to 500 psig.

The process provides for the conventional cooling of reactor effluent followed by separation of hydrogen and hydrogen sulfide. The treated liquid fraction is then stripped of residual hydrogen sulfide with product yields running 100 per cent of charge. Hydrogen-rich gas from the separator is recycled to the reactor in amounts varying with the specific requirements for each type of finishing.

Hydrofining will operate in conjunction with catalytic reforming as a modern quality improvement combination, employing byproduct reforming hydrogen to upgrade low quality reforming feeds and thus broaden the base of stocks which can be successfully reformed in some fixed-bed catalytic processes. It can refine sour olefinic fuels to reduce high sulfur content, stabilize cracked products, reduce odor, and prevent the formation of gum and carbon residue which foul engines and clog burners.

In addition, this process is being successfully employed to upgrade such specialty products as waxes, turbine oils, transformer oils, and premium lubricating oils. This refining step can result in the economic processing of many low quality crudes thus extending the available supply of petroleum.

Unifining . . . This process *(The Oil and Gas Journal, April 19, page 211)*, licensed jointly by Union Oil Co. of California and Universal Oil Products Co., is off to a fast start with nine units licensed. These units total over 80,000 bbl. per day in combined charge capacity. Parallel independent development work was undertaken originally by the two companies with Union calling their process "Unifining" and Universal terming theirs "Hydrobon." When the two efforts were joined, the name "Unifining" was adopted.

The process employs a rugged catalyst containing cobalt and molybdenum supported on alumina. For most of its commercial applications, the process will operate at pressures below 1,000 psi. and at temperatures up to 800° F.

Unifining is a very versatile process. Its most extensive application may prove to be in feed preparation for catalytic reforming. For this purpose the selective catalyst can convert straightrun naphthas high in sulfur, nitrogen and contaminant metals, thermally cracked naphthas and coker gasolines to feed stocks ideally suited to catalytic reforming platforming or other units employing platinum catalysts.

Sulfur removal is possible with all distillate stocks ranging from light naphthas and solvents to heavy vacuum gas oils. Cracked distillates can be upgraded with improvements in color and gum contents, imparting excellent stability characteristics. Both cracked and straightrun heavy distillates can be

upgraded to make high quality fuel oils or catalytic cracking feed stocks.

Pilot plant runs on low quality cat feed stock (a sour coker gas oil) have shown removal of 99 per cent sulfur and 78 per cent nitrogen. This unifined stock on catalytic cracking yielded 45 per cent more gasoline and 38 per cent less catalytic coke. Unifining also points the way for converting the highly contaminated tar sands coker distillate and shale oil distillate to gas oils equivalent in quality to those derived from sweet crude oils.

Autofining . . . The Autofining process *(The Oil and Gas Journal, September 8, 1952, page 67)* developed by Anglo-Iranian Oil Co., Ltd., differs from the other modern desulfurizing processes in that it is self-sufficient on hydrogen. The preferred catalyst, a mixture of cobalt and molybdenum oxides on alumina, combines the controlled dehydrogenation of naphthenes with the hydrogenation of sulfur compounds, the former providing the hydrogen required for the latter.

Reactor conditions can be varied from 5 to 200 psig. and 700° to 800° F. with commercial operations ranging about 100 psig. and 780° F. The process is used commercially to desulfurize straightrun gasoline, SO_2 extracts of 325° F. e.p. naphthas and 490° F. e.p. kerosines, power kerosine, gas oil, and long distillate comprising the naphtha-to-gas-oil boiling range. Hydrogen consumption averages 70 cu. ft. per barrel for feed stock running 1.0 per cent sulfur. Autofined stocks require no further finishing.

Since units of this type would be independent of outside hydrogen supply, their operation would not be interrupted by shutdown of catalytic reforming or other hydrogen producing facilities. On the other hand, autofining units are restricted in their internal hydrogen supply, to about 30 per cent of cracked material in the feed stocks.

Anglo-Iranian has also developed a catalytic hydrogenation process, which is termed Hydrofining. This employs the same catalysts as Autofining, but operates on external hydrogen. Operating conditions are more extreme, with pressures running from 500 to 1,000 psig.

Pilot plant tests of this operation show that it can be used to desulfurize all straightrun distillates, some cracked distillates, and crude-oil residues as well. The economics of the desulfurization of residuals may be marginal due to the higher cost involved in the higher pressure and hydrogen requirements. Units can be designed to operate on either process. A unit under construction in Kwinina, Australia, will receive hydrogen from an adjacent platformer and will be used to desulfurize kerosine and gas-oil mixtures.

Shell Hydrodesulfurization . . . The catalytic hydrogenation process developed by Royal Dutch-Shell in The Netherlands is commonly known in the industry as the "Trickle Process" *(The Oil and Gas Journal, June 8, 1953, page 92)*. It differs from others in its class in requiring no vaporization of the feed stock. The liquid to be treated flows downward as a thin film over the fixed-catalyst bed.

Two catalysts may be employed in this process. The cobalt-molybdenum-bauxite type is the less costly and is used for desulfurizing nonolefinic stocks. Hydrogenation of aromatics is minimized with this catalyst. The tungsten-nickel sulfide catalyst may be used in upgrading distillates by hydrogenation of aromatics.

Reactor pressures may range from 300-700 psig., the higher pressures being required for deep (80-90 per cent) desulfurization. Reactor temperatures average 700° F. At the higher pressures and temperatures, complete nitrogen removal is accomplished. Hydrogen consumption per pound of sulfur removed runs 50 cu. ft. for straightrun gas oil and 65 cu. ft. for catalytically cracked cycle oil.

The process can be used for:

. . . **Desulfurizing** straightrun distillates such as diesel fuel, lube stocks and burning oils.

. . . **Improving** the catalytic cracking characteristics of flashed distillates.

. . . **Upgrading** catalytically cracked light gas oils to diesel fuel and recycle stocks.

. . . **Upgrading** deasphalted vacuum pitch for catalytic cracking to reduce coke laydown and improve gasoline yield.

. . . **Upgrading** shale oil.

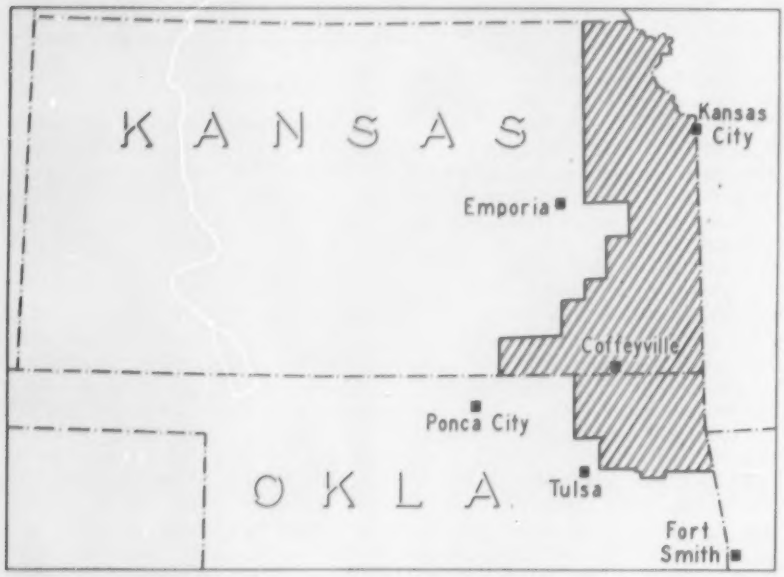
Other processes revealed . . . A hydrogen desulfurization process developed by Husky Oil Co. is being successfully employed in a small unit processing sour diesel fuel at the company's Cody, Wyo., refinery. Details of this operation, not presently available, will be published in an early issue of The Oil and Gas Journal in the form of a paper under preparation by Husky personnel.

Another hydrogenation process for pretreatment of catalytic reforming feed stock will be incorporated in Pure Oil Company's new unit at the Heath refinery, Newark, Ohio. This reforming unit designed by the M. W. Kellogg Co., will also be the first to employ the new Sinclair-Baker platinum catalyst in commercial operation. This operation is also presently under wraps, but information will be forthcoming on it sometime this summer.

Numerous hydrogen refining techniques are under intense study in the industry's research laboratories and in universities. The availability of cheap hydrogen has created a revolution in the economics of hydrorefining and widespread usage of this byproduct is anticipated to improve product quality and further to extend the conservation of petroleum.

Marsh Buggy Headed for Army Tests

An experimental model of the famous Marsh buggy prepares to undergo final tests at Gulf Oil laboratories, Pittsburgh, Pa., before being shipped to the Army for tests. The buggy is equipped with balloon tires 10 ft. in diameter that enables it to navigate like a motor boat, to climb steep banks, to cross boulder-strewn or soft sand beaches, and to roll over bottomless mire. Joe Halasowski stands on the fender of his jeep to pass a message up to B. M. Wedner, equipment design engineer who is at the controls of the buggy.



Shallow-Sand Boom

Fracturing is the key to the current 31-county drilling splurge which has made production soar in two-state area

TULSA. — Northeastern Oklahoma and eastern Kansas are currently in the midst of their biggest oil boom in 30 years.

More than 300 rigs are now drilling in the 31-county area (see map) in the most concentrated exploration and development program since Kansas' Golden Trend strike in the early 1920's.

Shallow, erratic Pennsylvanian sands are the principal target in the current campaign. Bulk of the work is being done by small independents, many of whom own and operate their own cable-tool rigs.

Responsible for the upsurge in activity is the development of formation fracturing, which has made the Cherokee sands a paying proposition. During 1953, for example, service companies reported an average of 80 fracturing jobs a month in northeastern Oklahoma alone. A 20 per cent increase in well completions for the two-state area is forecast for 1954, based on activity during the first 4 months.

Production has doubled in the 31-county area during the past 5 years. Although much of the increase is due to water-flood projects, a large part can be attributed to the active drilling campaign.

Pay thickness ranges from a few feet to 50 ft. or more, with an average probably between 10 and 20 ft. Depth to these pay zones varies from 100 ft. to about 2,500 ft., with the average well about 1,000 to 1,500 ft. deep.

Typical Well Costs

(Cherokee sand well, using all new equipment*)

Drilling costs at $2.25 per ft.	$2,700.00
10-in. casing	200.00
7-in. casing at $1.75 per ft.	2,100.00
Fracturing costs	700.00
Pumping equipment and surface installations	1,000.00
Rods and tubing	700.00
Day work	1,000.00
Total cost	$8,400.00

*Cost can be reduced 20-30 per cent by using second-hand equipment.

Producing zones . . . Main pay zones are the Cherokee sands of the Des Moinesian series

These sands first produced oil in Kansas in 1860. Development gradually spread southward, reaching Oklahoma in 1897. Cumulative production is about 3 billion barrels. An additional billion barrels will ultimately be produced through recent and new discoveries and water-flood projects.

Most production is from stratigraphic traps, caused by the lensing or shaling out of the Cherokee sands updip.

These Cherokee sands were deposited against an old land mass as the Cherokee Sea covered the area from east to west. The sands pinch out updip to the west. As a consequence, production from each sand is largely confined to a narrow belt that trends northeast-southwest.

Within the producing belt, the individual sands are extremely erratic in thickness and distribution. A well offsetting a good producer may have no sand present at all. Good producing areas are small aud spotty, but numerous.

Stratigraphy . . . In the middle Cherkee, the Boggy shale contains two important oil-bearing sands, the Red Fork and the Bartlesville.

The Bartlesville is the most persistent of the Cherokee sands; updip it is difficult to differentiate it from the Red Fork. Production is from anticlines and along the wedge edge where it lenses out updip.

The Red Fork produces along its updip limit. It is a lenticular, discontinuous sand and is a prolific reservoir in both Oklahoma and Kansas.

Oil is found in the Prue, or Squirrel, and the Senora, or Skinner, of the upper Cherokee section. These sands are lenticular and erratically distributed in eastern Oklahoma and eastern Kansas. The Prue accounts for much of the production in the shoestring sand fields of East-Central Kansas.

Drilling practices . . . Nearly all wells are drilled with cable tools, although some light rotary rigs are in use.

Surface pipe is set at 50 to 400 ft. depending upon the area and local conditions. It is sometimes necessary to set an intermediate string to shut off water-bearing formations. This string is pulled after the pay string is run.

Three methods of completing the wells are used:

. . . **Drilling through** the pay zone and fracturing through tubing with packer prior to running pipe. Hole is plugged back to the top of the pay with gravel; pipe is set and then the hole is cleaned out to total depth.

. . . **Setting pipe** on top of the pay and drilling in. Hole is fractured and tested either through the tubing or casing.

. . . **Drilling through** the pay and setting casing to total depth. The hole is tested and fractured through perforations.

About half the wells are completed through perforations and half through open hole.

To insure a good fracturing job, it is necessary to have a solid casing point and a good cement job.

Completion practices . . . Standard completion procedure is to fracture any sand that has a show of oil, no matter how poor the show may be. Experience has shown that even the slightest show will produce some amount of oil.

Sand-oil treatment varies with the operator, depth to the producing sand and its thickness.

The sand usually breaks under pressures of 800-1,800 psi. Occasionally higher pressures of 2,500 psi. are required because of the cement or mud against the face of the formation.

Cost per well . . . Cost of a producer ranges from $4,000 to $10,000. An average 1,200-ft. well will cost about $8,500, using new equipment. Many operators reduce the costs considerably by using second-hand material so that a well may cost only $5,000 to $6,000. Cost of a dry hole can be less than $3,000.

Drilling costs run about $2 to $2.50 per foot for a 1,000-1,500-ft. well.

Normal drilling time is about 7-10 days for a cable-tool hole. Wells are drilled and completed in 3 or 4 days if rotary tools are used.

Economics . . . It is difficult to evaluate the economies of the Cherokee sands, because pay thickness may give no indication of a well's initial potential. A thin pay section may make as much as 50 to 80 bbl. per day, which is considered good for this area. Most wells level off rapidly to about 20 to 30 bbl. per day or even less. Wells that come in for only 5 to 10 bbl. hold up and are economic.

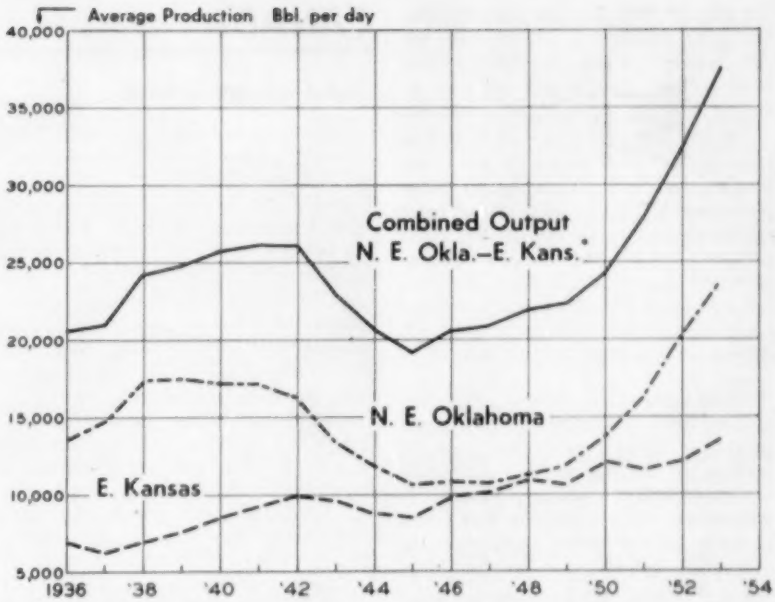
Gravity of the crude ranges from 30° to 45° A.P.I.

Operators estimate recoveries of between 100 and 150 bbl. per acre-foot. A well with only 10 ft. of pay will gross 12,500 bbl. of oil, assuming 10-acre spacing and a recovery of 125 bbl. per acre-foot. This would gross about $30,000 on an initial investment of $6,000 to $10,000.

Although each new well is considered a wildcat, it is obvious that operations can be profitable.

Much of the oil is trucked to pipeline connections, although wells in and near water-flood projects have pipeline outlets. Cost of trucking the oil is about 32 cents per barrel.

The outlook . . . Fracturing of the pay sands is the principal reason for the current drilling activity in northwestern Oklahoma and Kansas. Minor amounts of oil are produced from the Arbuckle, Oswego, Big lime and Pink lime. The Cherokee sands, however, account for most of the oil production in the two-state area.



Daily production in the past 5 years has doubled and is steadily increasing. Present output is in excess of 40,000 bbl. per day.

The shallow production, low cost of drilling, and favorable economies will continue to attract the small independent operator.

Crude Purchases Cut

Two Oklahoma firms institute pipeline prorating, others may follow suit; surplus set between 50,000-80,000 bbl.

TULSA.—Lack of adequate markets for Oklahoma crude has caused some purchasers in the state to institute pipeline proration and take less oil during the balance of May than the per-well allowables set by the Oklahoma Corporation Commission.

Sunray Oil Corp. announced that effective May 7 it would cut its purchases in Oklahoma by 30 per cent.

Sunray's proration will be "across the board" and will reduce runs by 30 per cent from all lease connections throughout the state, regardless of a well's allowable or actual production, whether it is in an allocated or unallocated pool, or in a secondary-recovery operation.

Rock Island Oil & Refining Co. followed with an announcement that its purchases in Oklahoma would be cut 15 per cent.

Several other purchasers said they are taking more crude currently than they can dispose of and their storage is nearing capacity. Most of them expressed hope they could get by during the balance of the month, but indicated they might have to begin pipeline proration by June unless allowables are reduced then.

What brought it about . . . The decision of these companies to begin pipeline proration followed the refusal of the Corporation Commission to reduce May allowables as much as requested by purchasers *(The Oil and Gas Journal, May 3, page 58).*

The commission estimated that its May allowable would result in production of 510,000 bbl. per day, but purchasers say that it would have averaged about 540,000 bbl. per day before pipeline proration was instituted.

The prorating companies explained that production of Oklahoma crude is running ahead of demand and that there is a surplus of aboveground stocks.

P. M. Broach, manager of crude oil sales and purchases for Sunray, said Oklahoma's production in May will still run 50,000 to 80,000 bbl. per day in excess of demand. Broach said Sunray has been nominating 17,000 bbl.

per day for the past year but recently has been purchasing 32,000 bbl. per day. Sunray's storage is "10 per cent over critical" and would continue to mount without cutbacks in purchases.

The pipeline proration was started in spite of an order issued by the commission last fall purporting to force purchasers to take all oil from any lease within the allowable set by the commission *(The Oil and Gas Journal, October 19, page 82)*. Company attorneys are convinced that this order is without force of law, and apparently the commission is not attempting to enforce it.

Protests ignored . . . Several other purchasers have protested that Oklahoma production is beyond market demand, both at the hearing on May allowables and since. Before pipeline proration was announced, the commission was asked to issue an emergency order reducing allowables below those set for May, but it refused.

Carter Oil Co., one of the companies which protested the May allowables, last week encountered new difficulties in disposing of its Oklahoma crude and was considering the possibility of instituting pipeline proration soon. It has 800,000 bbl. of Oklahoma crude in storage and only 50,000 bbl. of unused storage capacity. Carter has been buying 30,000 bbl. daily in Oklahoma.

Others involved . . . Two other firms released information to indicate the crude surplus is general throughout most of Oklahoma.

Dr. I. A. Anson, president of Ben Franklin Refining Co., Ardmore, one of the large purchasers of southern Oklahoma crude, said his firm's estimates show an excess of "some 40,000 bbl. of crude oil being produced in southern Oklahoma for which there is no satisfactory permanent or immediate future market."

"The market demand as evidenced by the purchasers' statements before the Oklahoma Corporation Commission has been from 50,000 to 100,000 bbl. per day less than the allowable production," Dr. Anson said. "Continued production above the market demand could ultimately result in tremendous physical waste as well as economic waste and be of serious future injury to both producers and refiners in the state alike."

A spokesman for Mid-Continent Petroleum Corp., one of the state's biggest purchasers, said the production allowables established in May are not causing the company any "immediate trouble," but said additional cuts in allowables would "create a much healthier situation within the industry."

CANADA

Team Brings in Well

REGINA.—Limited production tests of the Canadian Gulf-Canadian Quinn No. 9 Mississippian discovery well have shown a potential of 120 bbl. a day of 40.5° crude from an 18-in. section at the bottom of the pay zone, according to latest reports.

The well has been shut in at present due to government regulations which prevent commercial production until the two-company team has leased a designated area around the well.

The top of the pay zone in the Mission Canyon section was encountered at 4,633 ft. The well was drilled down to 4,655 ft. and 7-in. casing set to 4,654 ft. An additional 5 ft. was cored and then the well was plugged back to 4,648 ft. and drilled out to 4,652 ft.

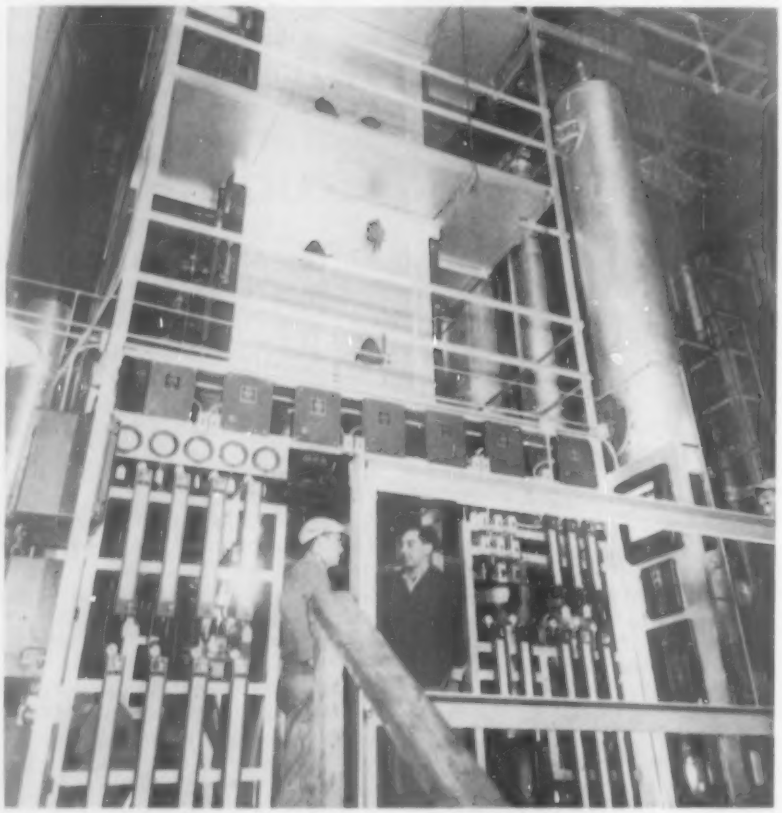
Crews entering to test the cement found the well flowing from a crack in the cement running approximately 18 inches below 4,652 ft. The well is located in LSD 9, 34-3-4w2, 24 miles east and 6 miles north of Estevan, Sask., which is 17 miles north of the United States border.

Canadian Venture Hits

REGINA.—The Government of Saskatchewan's first venture into the oil business has proved successful.

The Co-Op Dewar No. 9-11 development well, drilled by the Co-Operative Refiners, Ltd., on land farmed out by the Saskatchewan government, has been completed in the Viking sand as a flowing well.

The oil industry in Canada was disturbed recently by the Saskatchewan government's action in leasing the lands to Co-Operative Refiners, Ltd., and denying companies a chance to bid on lands after they had spent money developing surrounding areas.



Pilot Plant Makes Gas From Light Petroleum Liquids

The Institute of Gas Technology is operating a pilot plant pressure-gasification unit at the Crawford station of Peoples Gas Light & Coke Co., Chicago, making gas from light petroleum liquids to supplement gas supplies at peak load periods. In a typical operation using 100 gal. of 26-lb. R.v.p. natural gasoline as feed, the unit yields 72 cu. ft. of 1,250 B.t.u. gas per gallon of feed stock. The unit's furnace is in the center and the towers on the right are part of the product recovery system.

PEGASUS FIELD, relatively young as oil fields go and still under development, already has produced almost 17,000,000 bbl. of oil from the Ellenburger and Pennsylvanian formations. At upper right is the Pegasus gasoline plant and part of the plant camp site. Magnolia Petroleum rig in foreground is on Magnolia's John Windham "A" lease in Section 21.

Pegasus Flood Sought

Magnolia seeks Railroad Commission permission to flood pays at 10,000 and 13,000 ft. in "deepest" program yet

Robert J. Enright

DALLAS.—Approval of a huge unitization and pressure-maintenance program involving what is believed to be the deepest water flood ever attempted has been asked of the Texas Railroad Commission by Magnolia Petroleum Co.

The big unit as presently proposed takes in 16,252.916 acres in Pegasus field of Midland and Upton counties in West Texas. It may be swelled to almost 21,000 acres or more.

The two-pronged pressure-maintenance project calls for starting water injection into the Ellenburger formation at an average depth of 13,000 ft. and gas and water injection into the Pennsylvanian at 10,300 ft.

The Ellenburger flood, which at first would employ only one gas-injection well, later would be expanded to a field-wide peripheral injection program at a cost of about $6,000,000. This 13,000-ft. operation as far as can be determined is the deepest water flood ever undertaken.

The Pennsylvanian operation will include both gas and water-injection pilot projects. Water would be injected in a five-spot arrangement through four wells. High-pressure gas would be injected through one well. Either water or gas injection, depending upon which pilot performs best, would later be extended throughout the reservoir.

So far neither the Pennsylvanian nor the Ellenburger has been completely developed. There currently are about 183 wells completed in both reservoirs. If the proved acreage is completely drilled on the present 80-acre spacing arrangement, there will eventually be about 365 wells in the field—almost exactly double the present number.

There are 51 tracts in the proposed unit area, and testimony before the Railroad Commission developed that 43 of these are 100 per cent signed. To date over 99.5 per cent of the working interest and about 99.2 per cent of the royalty interest in the unit area has signed the unit agreement.

Magnolia, which discovered the field, is by far the largest operator, controlling about 79 per cent of the surface acreage in the field.

The company as a matter of policy will not reveal additional oil in barrels which it expects will be recovered as a result of the pressure-maintenance project. The company's share of the total additional oil, however, will be considerably greater, according to a company spokesman, than the 140,000,000 bbl. it would receive by virtue of its 14 per cent interest in the estimated 1,000,000,000 bbl. of additional oil resulting from the mammoth SACROC project in Kelly-Snyder field of Scurry County.

All equipment required for both water and gas-injection projects is either on hand or has been placed on order, and bids have already been asked for construction of a water-injection plant.

Compression facilities needed for the gas-injection operation already are available at the Pegasus gasoline plant, from which residue gas will be furnished for injection.

The Ellenburger . . . The Ellenburger formation in Pegasus field was discovered in March 1949. There are now about 107 wells producing from the formation—97 of them flowing, the other 10 on artificial lift.

If the total unit area is proved productive, as is thought probable, there ultimately would be about 175 wells producing from the reservoir. Cumulative production to the first of April was 13,595,671 bbl. There are at present 8,381 developed acres, with another 6,119 undeveloped acres considered reasonably proved.

The Ellenburger in Pegasus is an asymmetrical anticline with three crests. Gross pay thickness averages about 300 ft. Porosity averages 3.1 per cent, permeability 15 md. Drive is solution gas, and there is no gas cap. Original reservoir pressure of 5,668 psi. had declined by January 1, to 3,781 psi. (at —10,000 ft.).

Magnolia estimates that under primary methods the reservoir would yield about 18 per cent of the oil in place, and that pressure maintenance will increase this volume by 50 to 100 per cent.

Testifying for Magnolia at the Railroad Commission hearing, Fred S. Wright, Jr., division petroleum engineer, said it is intended to maintain reservoir pressure in the Ellenburger at about the saturation level of 3,210 psi.

Initially, he said, about 10,000 bbl. of water daily would be injected through Magnolia's George C. Fraser et al. WIW 1 in Section 33 in the extreme eastern portion of the field. The amount of water injected will represent 43 per cent of current reservoir voidage.

The Pennsylvanian . . . This pay, discovered later in March 1951, had pro-

duced 3,195,633 bbl. of oil to April 1.

There are 71 flowing wells in the reservoir, five more on artificial lift. If the formation should be found productive over the entire unit area, there eventually may be about 190 wells producing from this pay.

This pool, like the Ellenburger, is an asymmetrical anticline with three crests. Also like the Ellenburger, there is a solution gas drive and no gas cap. Reservoir pressure had declined from the original 4,567 psi. to 2,985 psi. (at —7,500 ft.) as of January 1.

The net pay averages about 70 ft. thick, with porosity averaging 4.6 per cent and permeability averaging 9 md.

There are 6,108 developed acres and 5,392 acres undeveloped but considered reasonably proved.

If pressure-maintenance operations are not undertaken, Wright told the commission, recovery will be only about 15 per cent of the original oil in place. Bottom-hole pressure would continue to decline and gas-oil ratios to increase, he said. With pressure maintenance, Wright said, ultimate recovery would be boosted 50 to 150 per cent.

Present plans call for injection of 4,850,000 cu. ft. of gas daily under a pressure of 4,700 psi. through the lone gas input well.

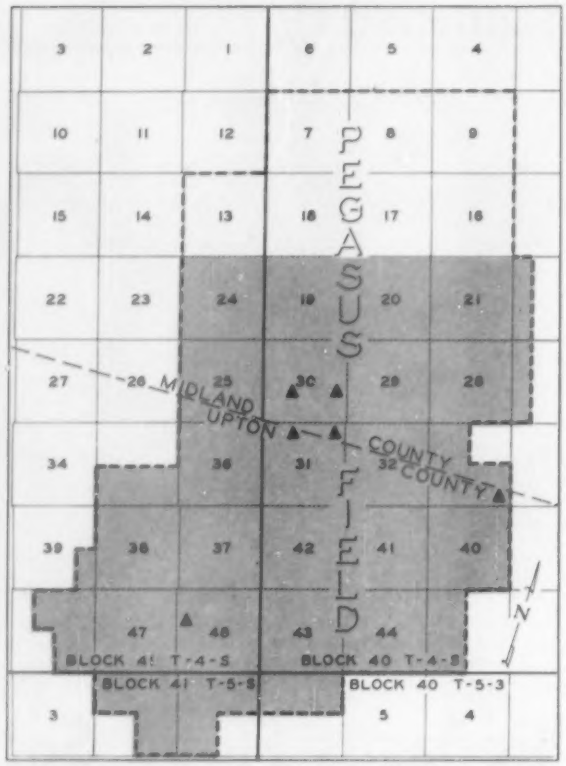
Roughly 1,000 bbl. of water per well would be injected through the four input wells in the water-injection pilot operation in the Pennsylvanian, the north-central part of the field.

Unit agreement . . . Participation factor in the unit for both the Ellenburger and the Pennsylvanian is based on acre-feet of pay.

Oil and gas from each formation would be produced and gaged or measured separately, then allocated to the pertinent formation. The agreement provides, however, that gas after being metered and tested for liquid content may be commingled.

Participation would be figured on the basis of acre-feet of pay under the acreage assigned by the Railroad Commission to a well. If the commission has assigned no acreage to a well, the agreement provides that such a well be assigned not more than 80 acres, with a tolerance of 30 acres for the last well on a lease.

This participation, however, would hold true only if the Railroad Commission assigned an allowable to an Ellenburger well of 200 bbl. daily or more of oil and to a Pennsylvanian well of 100 bbl. daily or more. If the assigned allowable is less than the specified figure for either formation, participation would be reduced proportionately.



PROPOSED UNIT AREA (shaded) takes in the entire Pegasus field except for 4,480 acres to the north, most of the latter controlled by Sinclair. Triangles designate initial pilot injection wells. At upper center of unitized area in Sections 30 and 31 are the input wells in the proposed five-spot pilot water flood in the Pennsylvanian. At right in Section 33 is the initial water input well for the Ellenburger pilot flood. The high-pressure gas input well in the Pennsylvanian is at lower left in Section 48.

Opposition . . . Dissension arose at the hearing on the project when Elmer Patman, attorney for Superior Oil & Gas Co., contended that Superior had sought to join the unit on the same basis as other operators and had been denied the opportunity.

Patman said Superior has two Ellenburger wells in an area of the field which had been reasonably proved by development. He called attention to provisions in the agreement setting one participation basis for operators who sign before its effective date, and another for those who sign after this date. He contended that Superior had been denied the right to sign prior to the effective date of the agreement, and that therefore the commission should not approve the agreement until it provided for the same participation basis for all parties.

R. F. Bryant, Jr., Magnolia landman in charge of unitization, challenged Patman's statement. He said that Superior had been continuously requested to join the unit.

Participants . . . There are 39 companies and individuals participating in the Pegasus unit, according to the operators agreement.

Twenty-two firms or individuals have production in both the Ellenburger and Pennsylvanian. Six have production only in the Ellenburger, 11 only in the Pennsylvanian.

Magnolia's participation percentage is about 80 per cent in the Ellenburger and about 70 per cent in the Pennsylvanian.

There are only five other operators with more than 1 per cent participation in the Ellenburger. These are Sharples with about 9 per cent, Phillips with 4, Gulf with 3, and Republic Natural Gas Co. and Gustave Ring, with about 1 per cent each.

In the Pennsylvanian reservoir, only three other firms have a participation percentage of over 1 per cent. These are Sharples with 18½ per cent, Phillips with about 5, and Gulf with about 3.

Antitrust Action Date Due

AUSTIN.—Ten major refining companies charged with violating Texas antitrust laws have been granted until May 21 to file arguments supporting their motions for a rehearing on a decision made early in April by the Third Court of Civil Appeals here.

The state charges the companies raised tank-wagon prices of gasoline uniformly in a conspiracy to "eliminate competition between themselves" in July 1949.

The Appeals Court overruled a 5-year-old verdict of an Austin district judge on grounds that the state failed to show a sufficient cause of action.

The case has been remanded to District Court for trial on its merits.

The defendants contend the price boosts were made when price controls were lifted by the Government, and that the boosts were long overdue and were the result of rising costs.

The companies involved are: Cities Service Oil Co., Continental Oil Co., Arkansas Fuel Oil Co., Gulf Oil Corp., Humble Oil & Refining Co., Magnolia Petroleum Co., Standard Oil Co. of Texas, Sinclair Refining Co., The Texas Co., and Phillips Petroleum Co.

Deep Strike Made

Buffalo gets flow of 920 bbl. from Strawn wildcat

HOBBS.—Buffalo Oil Co. last week completed its 25-A Baish as a Pennsylvanian Strawn discovery flowing 920 bbl. of oil a day.

It is the firm's second deep strike in Maljamar field, Lea County, New Mexico, and is approximately 1 mile northwest of a 1952 Devonian discovery.

Location of the new well in relation to settled production from shallow pays, and recent Pennsylvanian discoveries, is shown by the map. Stanolind Oil & Gas Co.'s discovery was the 1-AB State, in Red Lake field, which flowed 810 bbl. of oil daily from Pennsylvanian pay. Skelly Oil Co. 6-A Lynch, in Fren field, made initial potential of 196 bbl. a day from Pennsylvanian pay between 11,962-82 ft.

Fields along the Northwest Platform, with the exception of three discoveries shown, produce from Delaware, or Yates, sand of the upper Permian system, to the Clear Fork which is middle Permian.

Buffalo 25-A Baish flowed its potential from a 14-ft. section between 11,616-60 ft. The 920-bbl. gage was based on an actual flow of 111 bbl. of oil in 3 hours through 9/64-in. choke. Earlier drill-stem tests recorded even higher flow rates from the same pay. In addition, the well flowed at the rate of 30 bbl. an hour from a section in the basal Permian, and recovered oil on tests of an upper Pennsylvanian reef.

Texas Files Answer

State replies to charge by Moncrief

AUSTIN.—The State of Texas has filed its answer to a suit brought by W. A. Moncrief and associates in the 126th District Court challenging the constitutionality of Texas Railroad Commission orders approving the Scurry Area Canyon Reef Operators Committee Unit agreement and field rules for Kelly-Snyder field in Scurry County, West Texas.

So far no date has been set for the hearing.

Moncrief alleges that the commission refused to examine or pass on the fairness of the terms of the unit agreement and allowed SACROC to increase its share of the field production early in the primary life of the field *(The Oil and Gas Journal, April 19, page 108)*. This was done, Moncrief charges, at the expense of the plaintiffs and others.

The suit charges further that the adopted pressure-maintenance program is not patterned after accepted conservation practices and is dangerous in that several years might pass before its effects become fully felt. The program as approved, Moncrief charges, would cause irreparable damage to the field's best wells and leases, including those of the plaintiff.

The SACROC unit takes in nearly 50,000 productive acres in Kelly-Snyder and is the world's biggest water-flood project from the standpoint of acreage.

Stanolind Shutdown Upheld

SAN ANGELO, Tex. — A federal judge ruled here last week that a production shutdown, when ordered by the Texas Railroad Commission, isn't grounds for terminating a post primary oil lease with continuous production stipulations.

The suit for a declaratory judgment was brought by Mr. and Mrs. Homer H. Haby against Stanolind Oil & Gas Co. The Haby's sought to void a lease with Stanolind on a piece of acreage in the Spraberry Trend of West Texas.

They contended the lease should be terminated since it stipulated that Stanolind had to drill within 60 days after production halted. Production in the Spraberry was shutdown for about 9 months last year for excessive gas flaring by order of the Texas Railroad Commission. Stanolind admitted that no drilling was done on the land during the shutdown.

The San Angelo judge held that both parties to a lease are bound by restrictions imposed by the commission, since in such a case a company is forced to stop production through no fault of its own.

Plant Contract Let

Texas Gulf awards work for project near Odessa

ODESSA, Tex.—Texas Gulf Producing Co. has let contracts for construction of natural-gasoline plant about 5 miles northeast of here in Headlee multipay oil field of Ector County, West Texas.

The $2,000,000 plant will have a processing capacity of about 15,000,000 cu. ft. of natural gas daily from Headlee field. It will be built by O. L. Olson Co., Houston. Contract for design was let to C. F. Braun & Co., Los Angeles, Braun also will supervise construction.

Construction is scheduled to get under way by the first of July and to be completed before the first of the year.

Production of casing-head gas in Headlee field is reported running at about 6,000,000 cu. ft. daily. Texas Gulf officials expect this production to increase to near the plant's planned capacity by the first of the year.

Plant To Go On Stream

COLEMAN, Tex. — The $500,000 Andrew M. Howsley gasoline plant in the Glen Cove field in Coleman County is slated to go on stream later this month.

The plant will produce a heavy gasoline and a butane-propane product which it will process from 38 wells owned by Howsley and his associates in the south part of Glen Cove field.

Output Ability High

I.P.A.A. sets nation's productive capacity on January 1 at 8,669,500 bbl. daily, far above actual production

Henry D. Ralph

DENVER.—The United States had a capacity to produce petroleum at the rate of 8,669,500 bbl. per day last January, which was 1,741,300 bbl. per day more than was actually produced that month.

This is the conclusion of a report presented to the mid-year meeting of the Independent Petroleum Association of America by its committee on productive capacity. The committee was headed by R. G. Lawton, Magnolia, Ark., former director of production of the Petroleum Administration for Defense.

By January 1955, the committee estimated, the United States will have a capacity to produce at the rate of 9,105,000 bbl. per day.

The figures include all petroleum liquids, divided between crude oil and natural-gas liquids. Productive capacity is taken as the maximum efficient rate of production sustainable without significant loss in the total quantity that can be recovered ultimately from underground petroleum deposits.

CAPACITY TO PRODUCE 8,669,500 bbl. daily in the United States was reported by R. G. Lawton.

The January 1954 capacity was broken down into 7,925,500 bbl. daily of crude, and 744,000 bbl. daily of natural-gas liquids. Total production of both that month was 6,928,200 bbl. per day, giving the figure of 1,741,300 bbl. per day as unused capacity.

(Production of crude oil in January 1954 was 6,240,400 bbl. per day, which with 6,238,000 bbl. for December 1953 represented the low period in more than a year. Crude production during 1953 averaged 6,487,000 bbl. daily and during 1952 it was 6,228,000 bbl. per day. This suggests that the figure of 1,741,300 bbl. for unused capacity is on the high side).

The accompanying table, taken from the report, shows that total petroleum productive capacity in the United States has expanded from 7,300,000 bbl. daily at the beginning of 1951 to 8,669,500 bbl. daily at the beginning of 1954. This is an increase of 1,369,500 bbl. daily, or 19 per cent, in 3 years.

"The unused capacity over and above actual production of crude oil and natural-gas liquids, increased from 835,000 bbl. daily in January 1951 to 955,000 bbl. daily in January 1953," the report stated.

"During those 2 years, both capacity

U. S. Petroleum Productive Capacity—1951, 1953, and 1954

(Thousands barrels daily)

	Productive capacity at M.E.R.			Actual production			Unused capacity at M.E.R.		
	Crude oil	Natural-gas liquids	Total	Crude oil	Natural-gas liquids	Total	Crude oil	Natural-gas liquids	Total
JANUARY 1951, ESTIMATED BY NATIONAL PETROLEUM COUNCIL									
District 1	54	19	73	54	19	73			
District 2	1,083	72	1,155	1,077	72	1,149	6		6
District 3	4,161	383	4,544	3,525	377	3,902	636	6	642
District 4	350	9	359	292	7	299	58	2	60
District 5*	1,079	90	1,169	959	83	1,042	120	7	127
Total United States	6,727	573	7,300	5,907	558	6,465	820	15	835
JANUARY 1953, ESTIMATED BY NATIONAL PETROLEUM COUNCIL									
District 1	49	19	68	49	19	68			
District 2	1,238	98	1,336	1,181	89	1,270	57	9	66
District 3	4,686	481	5,167	4,004	456	4,460	682	25	707
District 4	394	9	403	327	8	335	67	1	68
District 5*	1,098	87	1,185	990	81	1,071	108	6	114
Total United States	7,465	694	8,159	6,551	653	7,204	914	41	955
JANUARY 1954, ESTIMATED BY INDEPENDENT PETROLEUM ASSOCIATION OF AMERICA									
District 1	47.5	22.4	69.9	45.9	22.4	68.3	1.6		1.6
District 2	1,325.0	115.0	1,440.0	1,135.7	110.2	1,245.9	189.3	4.8	194.1
District 3	4,952.0	502.0	5,454.0	3,694.5	459.2	4,153.7	1,257.5	42.8	1,300.3
District 4	466.0	9.6	475.6	364.4	8.6	373.0	101.6	1.0	102.6
District 5*	1,135.0	95.0	1,230.0	999.9	87.4	1,087.3	135.1	7.6	142.7
Total United States	7,925.5	744.0	8,669.5	6,240.4	687.8	6,928.2	1,685.1	56.2	1,741.3

*Includes Elk Hills Naval Petroleum Reserve.

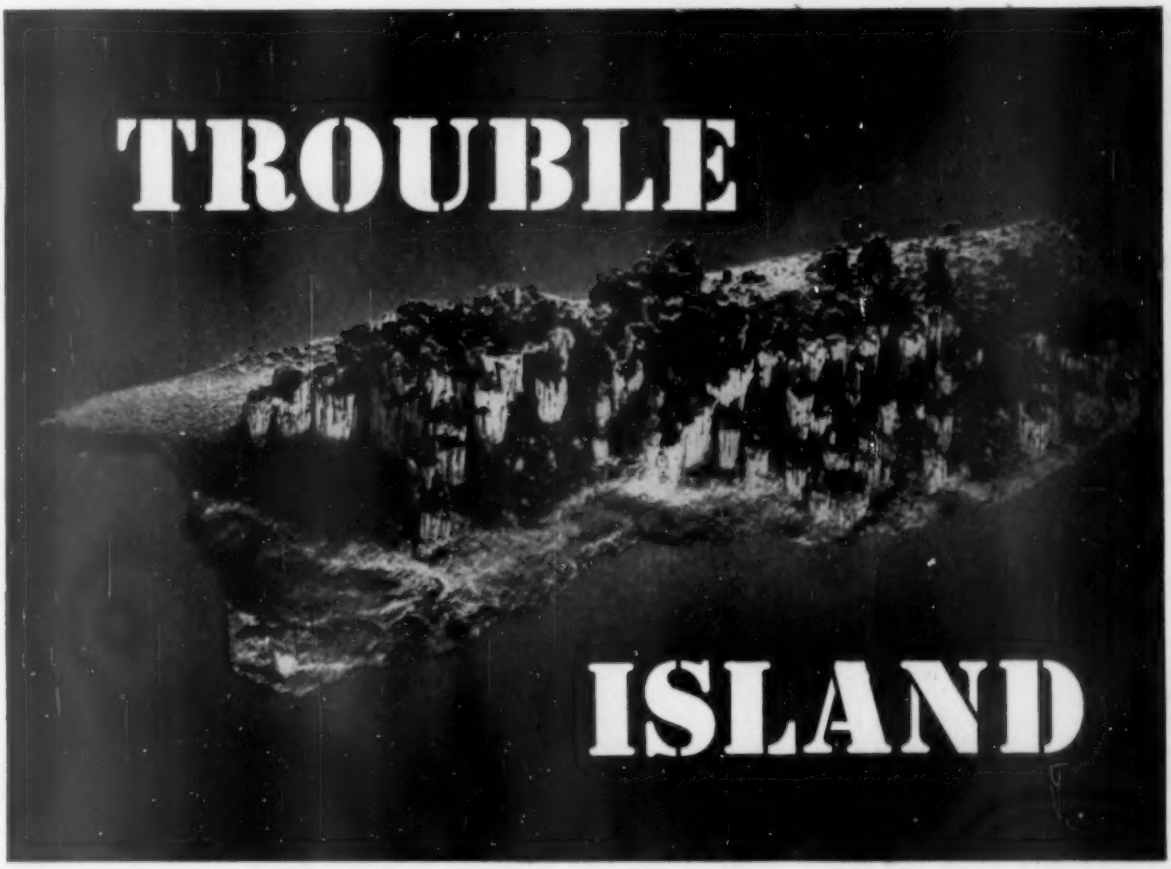


Photo is of a condenser-tube scale sample, about eight inches long. Solid scale is approximately ¼-inch thick, with "spires" ranging up to ⅜-inch height.

FIFTEEN years ago, this small island of trouble was part of a much larger open-box condenser problem at a refinery. Cooling water, running over 200°F. at outlet, contained 30 grains per gallon hardness and 20 parts per million iron. Tubes scaled heavily and rapidly without chemical inhibitor. Even with the best inhibitor then known, results were as illustrated above: partial inhibiting action creating the "spires" or forest-like deposits on tubes.

Considering this a challenge, Nalco sent a Doctor of Physical Chemistry — an expert water technologist — to the refinery. His weeks of work on the spot led to basically different treatment with new chemicals which cleaned up the condenser and kept it clean. Further Nalco research and development of chemical inhibitors has since enabled cooling systems to operate without scale or corrosion *with water hardnesses as high as 200 grains per gallon.*

Point is this: neither Nalco nor anyone else had an answer to scaling in that condenser. Nalco put the necessary brains to practical use and *got results* . . . benefiting, in the long run, not only that particular refinery, but every user of cooling water.

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and production increased substantially, with the expansion of capacity exceeding the increase in production by 120,000 bbl. daily. From January 1953 to January 1954, however, production was curtailed, while capacity continued to expand. As a result, unused capacity at maximum efficient rates increased to 1,741,300 bbl. daily in January 1954."

Assumptions . . . In making its forecast for capacity in January 1955, the committee assumed that the industry would drill 49,250 wells during 1954, of which 25,400 would be oil wells and 23,850 would be gas, dry, and service wells. It also assumed that the new wells completed in 1954 would have an average capacity to produce 41.1 bbl. per day, and that the capacity of all wells producing at the beginning of 1954 would decline 8.3 per cent during the year.

This formula produced the forecast of a January 1955 capacity to produce 8,320,000 bbl. of crude and 785,000 bbl. of natural-gas liquids daily, or a total of 9,105,000 bbl. per day of all petroleum liquids.

"This outlook," said the report, "indicates an expansion of about 435,000 bbl. daily, or 5 per cent over the capacity existing at the beginning of year."

Imports Action Asked

But I.P.A.A. carefully avoids request for quota, tariff, or other specific in asking Congress to solve problem

DENVER. — A resolution calling on Congress to adopt legislation "to correct the condition created by excessive oil imports" was adopted by the Independent Petroleum Association of America here at the close of a 2-day mid-year meeting at which imports was the principal topic of discussion.

The association thus deliberately avoided recommending any specific means of limiting imports, such as tariff, quota, or administrative procedure. It recommended no definite ceiling on volume of imports.

Members explained that this leaves the I.P.A.A. in a position to support any form of legislation which seems desirable or expedient. By taking a flexible position, the association hopes to enlist the support of other elements of the oil and other industries interested in the same general objective.

"This is not a fighting document," it was admitted by W. L. Stewart of Fort Worth, chairman of the import policy committee. "Its language is not as strong as what might be justified by the situation. We're not mad at anybody. The resolution does not pin-point the approach, nor aim at any particular country."

What it said . . . The resolution pointed out that in recent months imports have not been reduced but are scheduled to increase; the availability of domestic oil proves that imports are supplanting it to an increasing extent; and repeated reductions in domestic production without corresponding reductions in imports violate the principles of equity.

"The facts show imports to be excessive by every accepted standard," the resolution stated. "Imports of both crude oil and fuel oil have an established and accepted place in United States foreign trade. Excessive shut-in domestic production, or depressed fuel-oil markets below parity with competing fuels, have constituted evidence that imports have gone beyond justifiable levels."

It pointed out that importing companies as a group have not reduced imports by voluntary action and that no solution has yet been formulated by administrative agencies of the federal Government.

"The dangers confronting the domestic oil industry are real and immediate," it said. "Further delay leads to dependency on foreign oil. We must not render our country defenseless in one of the most vital munitions of war.

"As in the past, we would support a prompt and effective solution by any means short of legislation. Such means not now being available or forthcoming, our national interest impells us to act before it is too late."

Get outside support . . . Excessive imports were criticized at the meeting by the heads of two large companies not members of I.P.A.A.—Humble Oil & Refining Co. and Union Oil Co. of California—as well as by speakers who are members of the association. Statistical studies supporting the contention that imports are excessive were presented in the reports of the committees on supply and demand, productive capacity, and cost study. *(See separate stories on committee reports).*

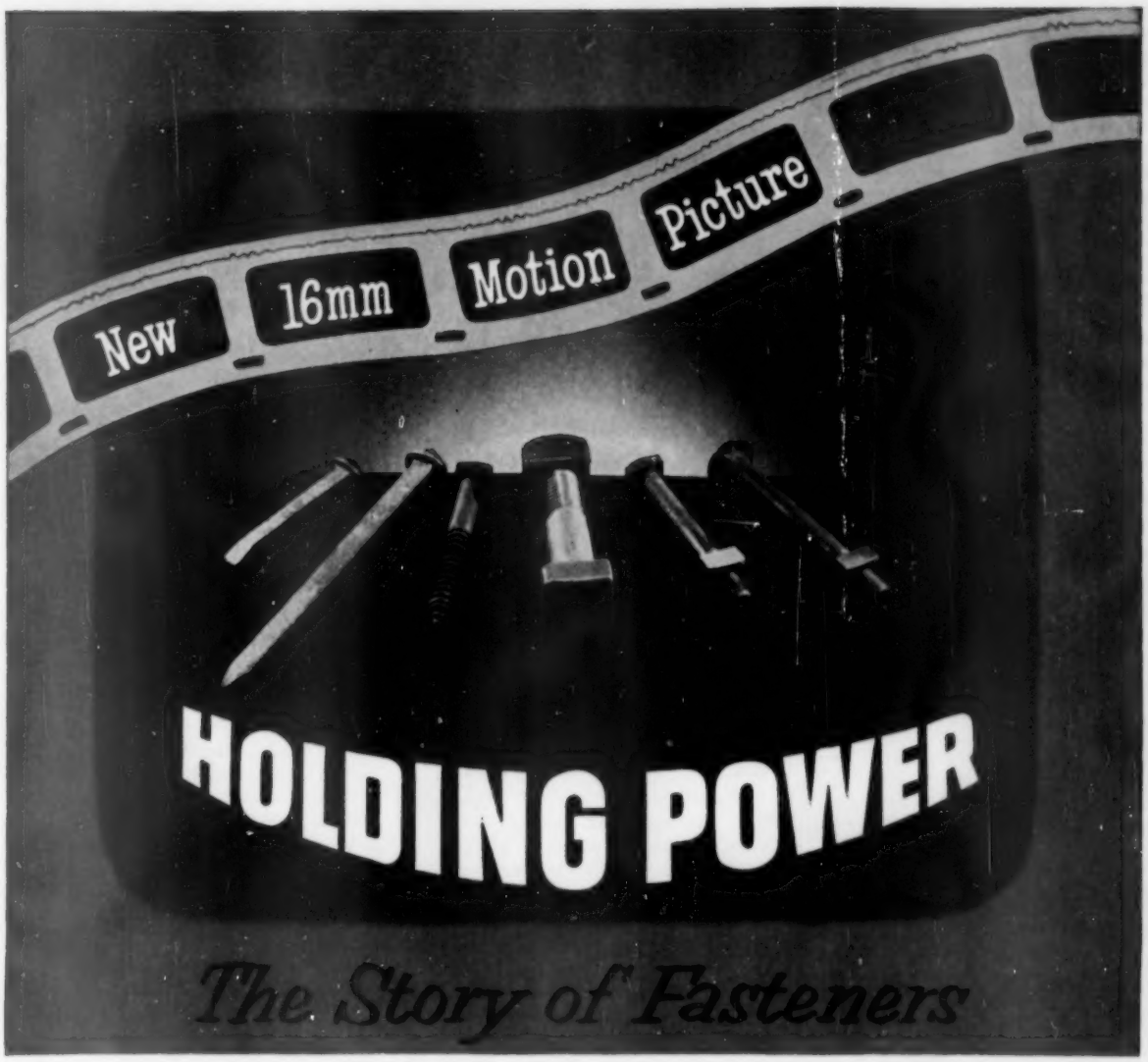
Crude-oil imports should have been reduced in 1953 and should now be reduced substantially below the 1953 rate, it was declared by Hines H. Baker, president of Humble, a subsidiary of Standard Oil Co. (N. J.).

"For reasons of national security, the United States cannot afford to become unduly dependent upon foreign oil," Baker said. "The amount of crude oil needed to supplement domestic supplies depends upon the changing relation between domestic demand and domestic production available under good conservation practices, probably after maintaining a million barrels daily of reserve capacity for national security reasons."

Baker cited 1947 and early 1948 when production was operating at a maximum efficient rate as a time when added imports are justified, but said imports should be cut at such times as 1949 when demands failed to increase.

He said if importers refuse to vol-

FOUNDING FATHERS of the I.P.A.A. were honored at the Silver Anniversary meeting. Among those present: Harold B. Fell, executive vice president; Wirt Franklin, president, 1929-35; Frank Buttram, president, 1939-43.



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"Holding Power" is in color, with sound. It is on 16mm film, and has a running time of approximately 30 minutes.

"Holding Power" is an ideal film for showing to distributors, consumers, and others closely associated with fasteners. It is also an interesting, highly educational picture for general audiences. There is no charge, except for the return postage. If you would like a print for showing, fill out the coupon, selecting a date well in advance, and mail it to Publications Department, Bethlehem Steel Company, Bethlehem, Pa.

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untarily cut imports, domestic producers should have the preferred position in providing crude oil rather than be placed at a disadvantage of operating under regulations while importers are permitted to operate freely.

Big company aid seen . . . Some larger oil companies will join in a fight against imports of foreign oil if the I.P.A.A. will take an active lead, it was predicted by A. C. Rubel, vice president of Union.

Rubel virtually accused the independents of getting soft, and urged them to take action to cut down the flow of foreign crude which he pictured as endangering the domestic industry.

"It is perhaps not in good taste for me, as your guest, to venture to criticize this organization—and if I were to do so it would be to say that I have sensed a decided lack of the old fight that has always characterized you in the past.

"Can it be that during the last few years of prosperity our independent producers have grown too fat and complacent to recognize and to battle for their principles?

"Remember—it's always the fat hog that goes to market."

Rubel said that a surplus of foreign oil imported into the United States amounted to 500,000 bbl. per day in 1953 and this pressure will increase unless restricted.

Possible action . . . There are three courses of action, he said:

. . . Permit unrestricted free flow of imports.

. . . Depend on the good judgement and statesmanship of importing companies to voluntarily restrict to domestic needs.

. . . Regulate imports by legal controls.

He opposed unrestricted imports because the world is producing more crude than it can use, pointing out that the only way foreign crude can be marketed is by cutting back corresponding quantities of domestic production.

Rubel said domestic producers are forced by state control laws that are designed as conservation measures to shut in production to make room for "unneeded imports."

"In other words, you are forced by your own state control laws to subsidize imports in which you have no beneficial economic interest," he said.

Rubel said it is a "laudable ambition" to raise the productive standards of Europe and Asia, but said such action should not be taken by deliberately reducing the productive standards of the United States.

He added that foreign trade should be expanded so that it will be beneficial to the over-all economy of the country, but said this trade should be based on mutual benefit and not on a one-sided basis "where whole segments of our economy are sacrificed for the benefit of a few."

PORTRAIT OF WIRT FRANKLIN, first president, by famous portraitist J. Anthony Wills, will hang in I.P.A.A. Tulsa headquarters building. Russell Brown, general counsel, helped Franklin unveil it at the Denver meeting.

Voluntary restriction of imports is the "desirable and sensible way" to solve the import problem, Rubel said, adding that "another sincere and all-out effort" for voluntary restrictions might be made under the auspices of the National Petroleum Council before it is "to late."

"A program of voluntary restrictions of imports to meet suplemental needs could well be formed within the framework of the NPC national petroleum policy if there is a real desire on the part of the industry to do so—a sort of interstate compact on a global scale," he said.

In regard to legal restrictions, Rubel said he preferred a flexible tariff to a system of quotas, but in any case they should be applied with our own economic and military self-interest as the guiding principle. This means, he said, giving preference first to oil from Canada and Mexico and then from Venezuela and other parts of the Western Hemisphere.

More imports forecast . . . The report of W. M. Vaughey, president of I.P.A.A., reviewed attempts made by officers of the association during the past year to find some solution to the imports problem short of legislative restrictions.

All approaches, both to importing companies and government officials, produced nothing but a recognition of the seriousness of the situation, he said. Continued high imports in the face of curtailed domestic production violates the spirit of the national oil policy to an extent which constitutes "intellectual dishonesy," he added.

"From sources that I am not at liberty to discuss," Vaughey said, "it is evident that in 1954 we will see increases in the volume of imports, rather than decreases."

"Today we think of the importing companies as being comprised of approximately six or eight companies. Besides the companies that usually come to mind, one of the things that causes me a great deal of concern is the alarming number of potential importers that I believe I now see standing on the side lines.

"If some restrictive legislative measure is not adopted, I believe in what might be a very short time our problem as it exists today, volumewise, might be but a drop in the bucket as to what could happen to us."

New International Union

PARIS, France.—O. A. Knight, president of the Oil Workers International Union (CIO) has been elected president of the new International Federation of Petroleum Workers which was organized here by representatives of 14 nations.

The body asks for free negotiations and the right of workers to conduct collective bargaining and to strike if necessary. Its objects were described as organization of workers in the field, the study of social and economic prob-

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lems, and opposition to exploitation and attacks on human rights from any source.

The founding convention was attended by delegates from Austria, Belgium, Canada, Chile, Colombia, Egypt, Germany, India, Italy, Lebanon, Netherlands, the Philippines and the United States.

Big Sale Approved

Interstate Natural to sell pipeline facilities to Olin

WASHINGTON. — Purchase of the pipeline facilities of Interstate Natural Gas Co. by Olin Interstate Corp. for $40,000,000 was approved last week by the Federal Power Commission.

The FPC approval was granted on the condition that Olin submit within 45 days evidence that it has been relieved of any obligation in regard to a $32,000,000 mortgage incurred to purchase the Interstate stock.

Olin Interstate was organized in June 1953 as a subsidiary of Olin Industries, but last November became a wholly owned subsidiary of Olin Oil & Gas Corp., which itself is a subsidiary of Olin Industries. The parent company financed the acquisition of 99½ per cent of the stock for $40,000,000 by having Olin Interstate sell $32,000,000 in notes to Prudential Insurance Co. of America.

The company told the commission that Olin Interstate would record the acquired properties on its books at the original cost of about $16,000,000, including construction in progress, and record an acquisition adjustment of approximately $24,600,000 representing the difference between the cost to Olin Interstate of the Interstate Natural stock and the net original cost of the latter's plant.

The commission ruled the acquisition could be consummated only if Olin Interstate records the property at net original cost and does not assume the $32,000,000 debt.

Gas Line Approved

LAMBERTVILLE, N. J. — Work will begin immediately on Texas Eastern Penn-Jersey Transmission Corp.'s 265-mile, 24-in. line from Oakford storage field to Lambertville, N. J.

Texas Eastern Penn-Jersey received Federal Power Commission approval at the same time its parent company, Texas Eastern Gas Transmission Corp., received authority from the FPC to construct the Oakford storage field.

The line, which will cost $31,000,000 and have a capacity of 204,000,000 cu. ft., will connect with Texas Eastern's system near Lambertville. The line will be leased to and operated by Texas Eastern which plans on having it in opeartion by this fall.

At the Oakford storage field, Texas Eastern will store 12,000,000 M.c.f. of gas a year for 20 years for Transcontinental Gas Pipe Line Corp. Transcontinental will take the gas at a daily maximum rate of 133,500,000 cu. ft. during the winter and will pay it back to Texas Eastern during the summer.

Layout Changed

SOME things have been moved around inside the Journal's covers. In this issue, for example, you'll find the "Personals" section has been moved to a position between "Exploration" and the Journal's "Statistics" pages. Too, you'll find a much larger number of consecutive editorial pages in the "Engineering-Operating" section.

The changes were made to permit us to do two important things: Expand our news coverage to give you more pages of up-to-the-minute information on activities within the industry, and arrange our engineering-operating pages to provide a greater concentration of editorial material and achieve a better presentation.

It is our feeling that the new makeup will give you more editorial material and, at the same time, make the Journal easier to read. We hope you like it.

River Crossing Proposed

HOUSTON.—Trunkline Gas Co. has filed an application with the Federal Power Commission to construct new crossings of the Mississippi River.

The company proposes to spend $2,960,000 to construct two 24-in. lines, crossing the river just north of its present crossings in the Greenville, Miss., area.

The new project will include interconnecting lines to link them with the old system. The company plans to use both the old and the new crossings simultaneously although the old lines have deteriorated to where the company considers them in possible danger.

Price Gets United Gas Job

CHARLESTON.—United Gas Fuel Co. of Charleston has awarded construction of a 57-mile, 30-in. pipeline in West Virginia to H. C. Price Co.

Right-of-way clearance has begun and present plans call for the pipe laying to begin early in May. Price has set September 1954 as the tentative completion date.

United will receive its gas from Gulf Interstate Gas Co. at Catlettsburg, Ky., when the latter finishes its 860-mile, 30-in. line from Acadia Parish, Louisiana, this summer.

Line Unsettled

Twin Cities crude link still in planning stage

HOUSTON.—Two pipeline companies, Minnesota Pipe Line Co. and Sioux Pipeline System, are still in a quandry concerning proposed lines into the Twin Cities area of Minnesota.

Minnesota Pipe Line Co. has indicated that it will build a 156-mile line from Fosterton to Regina, Sask., to connect with the Interprovincial-Lakehead system to transport crude to the planned Great Northern refinery in the Twin Cities area.

Sioux Pipeline System, a joint project involving 12 companies, has proposed a line from the Williston basin area to the St. Paul-Minneapolis region.

The latter project is being studied by Shell Pipe Line Corp. to determine its economic feasibility but so far the Shell committee has not issued its report.

Great Northern officials have indicated that the Minnesota Pipe Line project probably would be selected over the Sioux. One official of the refining company has expressed doubt that the Williston basin reserve is great enough to justify building the Sioux line.

The refinery, which will have a 20,000-bbl. per day capacity, is up for bids now and is slated to be completed by late 1955.

Iroquois Line Approved

WASHINGTON.—The Federal Power Commission has authorized Iroquois Gas Corp., of Buffalo, N. Y., to construct a 24½-mile 20-in. natural-gas transmission line to Erie County, New York.

The line, which will cost $1,540,000, will extend from Elma, N. Y., to Tonawanda, N. Y., and will have a maximum capacity of 60,000,000 cu. ft.

CORRECTION

In the May 3 Journal news account of the West Texas Short Course on Oil Lifting Methods (Page 60, second column), the presentation of the paper devoted to gas-lift principles should have been credited to Harold Winkler, of Camco, Inc., Houston.

On the CRUDE OIL and PRODUCTS PIPE LINES across America . . . . . .

The trend is toward NORDBERG POWER!

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For further details, send for Bulletin 191.

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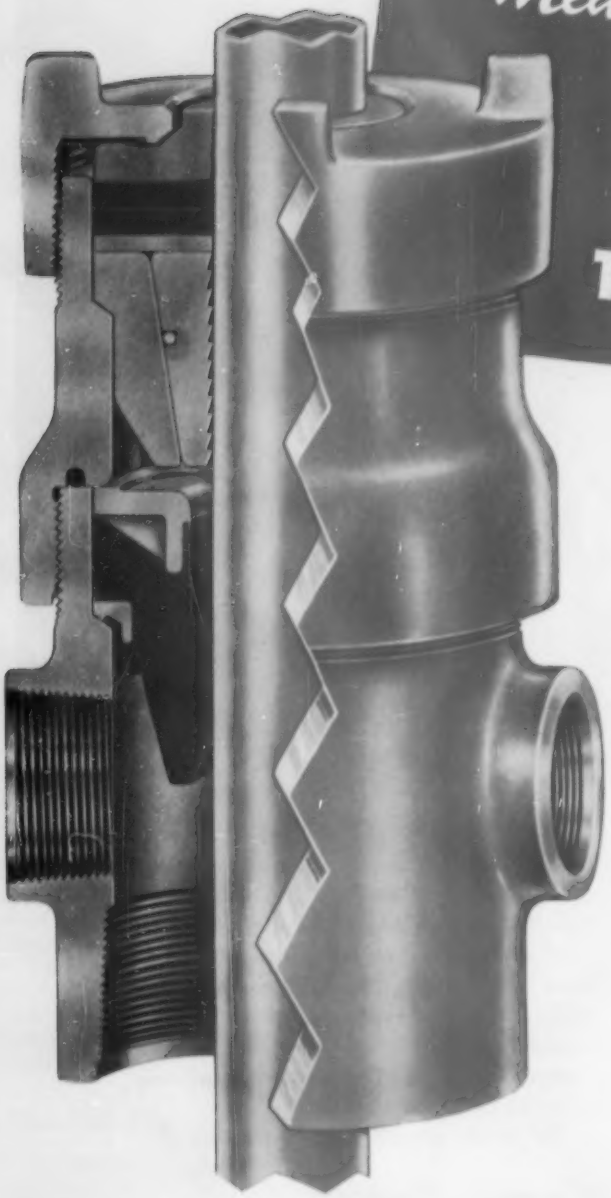

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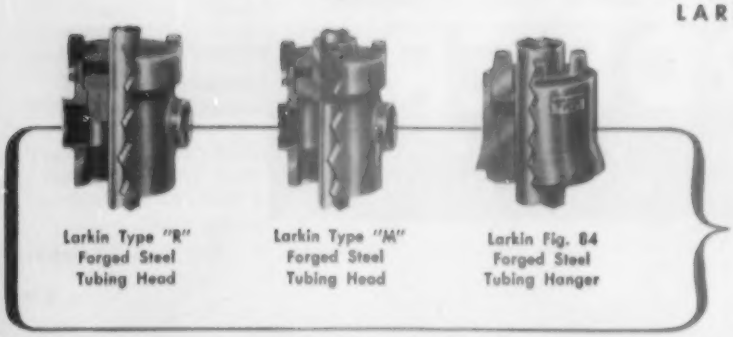
Type "SR" (large illustration) A slip suspension head equipped with a Neoprene Stripper in addition to the Hycar Split Packing Rings. The Neoprene Stripper provides effective control during workover operations.

Type "R" A slip suspension head that may be converted to or from the Type SR by the addition or removal of the Neoprene Stripper and Stripper Adaptor.

Type "M" A mandrel suspension head which may be threaded to accommodate tubing of any size. The Stripper Rubber and other parts are available for the smallest syphon or "macaroni" strings.

LARKIN PACKER COMPANY, INC.
St. Louis, Mo.



Larkin Type "R" Forged Steel Tubing Head

Larkin Type "M" Forged Steel Tubing Head

Larkin Fig. 84 Forged Steel Tubing Hanger

LARKIN

...Through Your Supply Store

Tanker Policy Boosted

Commerce Department report urges Congress to adopt new "trade-in-and-build" program to bolster tanker fleet

WASHINGTON. — A "trade-in-and-build" tanker program was recommended to Congress last week by the Commerce Department as a means of overcoming a shortage of tankers in the reserve fleet.

The views of the department were laid before a Senate commerce subcommittee by Robert B. Murray, Jr., undersecretary of commerce for transportation, in a 125-page report.

The strong competition which U. S. tanker operators are meeting from foreign-flag vessels "is expected to continue for some time to come," the subcommittee was told.

Although our export oil movement has declined sharply in the past 15 years, from 18,600,000 tons in 1937 to about 10,900,000 tons in 1952, the inbound petroleum movement has increased greatly, from about 10,400,000 to 51,500,000 tons in the same period.

"It is obvious therefore that an opportunity existed for increased tanker employment," the department commented, adding "if such data were the only criteria for determining the success or failure of ship operations, one could be optimistic about the position of United States-flag tanker vessels in the foreign trade, especially since between 1937 and 1952 they had obtained a substantial share of the increased petroleum traffic."

How it happened . . . However, it was pointed out, that situation was due to a combination of factors—a short supply of tankers, the 50 per cent cargo preference policy and high rates—which made it possible for American tankers to operate freely in competition with low-cost foreign-flag carriers.

"Tankers are now in a surplus position not because traffic has decreased, but because many new tankers were built within the past few years. As a result, tanker rates have fallen to very low levels and the high-cost United States-flag tankers are meeting with strong foreign-flag competition—a condition which is expected to continue for some time to come."

By far the most serious deficit of the reserve fleet is the lack of tankers necessary to meet the demands which would be created by a grave national emergency, the report stated, and it was to this situation that it directed its recommendations.

Possible solutions . . . "This problem may be solved in several different ways. Dependence could be placed upon our ability to produce in time of emergency a large number of tankers. This course would obviously impair other vital defense production. Alternative, we could stockpile in peacetime the entire number of tankers needed to meet estimated mobilization needs.

"A middle course, however, has been generally held a more practical approach to the problem. Consequently, the so-called 'trade-in-and-build' tanker program was presented by the Secretary of Commerce to Congress in July 1953, a program which should be actively pursued. Additionally, the Military Sea Transportation Service has under consideration the chartering of newly constructed tankers and at the same time transferring government-owned currently active T-2 tankers to the reserve fleet."

The department admitted there are aspects of the trade-in program which would have to be settled before a policy could be adopted, suggesting that it might be necessary to establish a statutory trade-in price combined with finality of contract.

Ball Replies to Senator

WASHINGTON.—A suggestion by Sen. Guy Cordon of Oregon that letters favoring increased appropriation for the Oil and Gas Division were "induced" brought a sharp retort last week from Max W. Ball, Washington oil and gas consultant who was first director of the OGD.

Cordon, chairman of a Senate appropriations subcommittee in charge of Interior Department funds, was reported as having said letters urging an increase in the $100,000 allowed OGD by the House would be placed in the record but indicated he did not feel that they were spontaneous.

Ball, who had written letters to the subcommittee urging that OGD be given the full $300,000 requested by the department, immediately advised Cordon that they were wholly spontaneous and no one had asked, suggested or hinted that he interest himself in the matter.

"I read in the trade press what the House committee had done to the OGD appropriation, I thought the action was mistaken, and I wrote you about it," Ball declared.

Coal Group Formed

Coal-producing state heads gird for oil imports fight

WASHINGTON.—A permanent fuel conference has been set up by the governors of the coal-producing states to seek legislative restrictions on imports of foreign residual oil.

A "crusade" against imports on behalf of the coal industry will be launched by the conference, Gov. John S. Fine of Pennsylvania, who initiated the movement, has declared.

Fine will serve as chairman of the conference, with Govs. Frank J. Lausche of Ohio, Lawrence W. Wetherby of Kentucky, George N. Craig of Indiana, Johnston Murray of Oklahoma, William C. Marland of West Virginia and William G. Stratton of Illinois on the executive committee.

Major purpose of the organization, will be to formulate a program for guaranteeing adequate fuel supplies for both peacetime and national emergency.

The conference already has petitioned congressional delegations from the coal-producing states to work for legislation against increasing imports of foreign residual which it declared has inflicted "great damage" on the coal industry.

"The problem of immediate concern," Fine said, "is the prevailing foreign trade policy that permits excessive imports to damage American industry and to create widespread unemployment in this country. This is the subject to which we shall devote our immediate attention, and I am hopeful that we will be able to project a recommendation to Congress within a short time."

Military Oil Board Named

WASHINGTON.—A new 21-member Military Petroleum Advisory Board has been set up by Interior Secretary Douglas McKay.

The board will advise the Assistant Secretary of Defense for supply and logistics and the Assistant Secretary of Interior for minerals on oil and gas matters relating to the national security and defense.

The board was originally set up in

1949 by former Secretary Oscar L. Chapman. It was inactive during the Korean emergency and the life of the Petroleum Administration for Defense.

The new board members were appointed for terms ranging from 1 to 3 years. They will elect their own chairman and vice chairman.

All branches of the industry and independent operators as well as major companies are represented on the committee.

Crude Line Opposed

Coal states ready to fight Gulf-to-East Coast pipeline

WASHINGTON. — Congressmen from the coal-producing states are prepared to fight any expenditure of government funds for construction of a Gulf Coast-East Coast defense crude-oil pipeline.

When proposal of the Defense Department for a big-inch line which the petroleum industry has refused to construct at its own expense was laid before the House last week by Rep. James E. Van Zandt of Pennsylvania, who declared the Government should reject the "fantastic scheme."

Van Zandt told the House existing facilities for oil transportation are adequate for war needs, particularly if the coal industry is given some support.

"It is not in the public interest for the Government to underwrite unnecessary expenditures that have no public merit and would serve only to create further displacement of America's mine workers and railroad employes," Van Zandt asserted.

PAD report made . . . A full report on its study of the pipeline and possible alternatives was sent to the Office of Defense Mobilization by the Petroleum Administration for Defense as it prepared to go out of business April 30.

PAD reportedly told Mobilization Director Arthur S. Flemming that neither the oil nor gas industry is willing to undertake construction of a line that would not be economically feasible in peacetime and might never be needed for defense purposes.

The report also discussed the possibilities of stockpiling pipe, laying out the right-of-way, and doing the design engineering for a line to be built if and when needed. It also discussed the apparently more favorable alternative of linking up existing gas lines whose load could be taken over by other systems and building only such interconnections and short strips as might be necessary to turn them into a system which could be used for crude oil transportation.

WATCHING WASHINGTON

Bertram F. Linz

Tanker Figure Secret

The Defense Department has definite figures on the facilities for petroleum transportation that would be required in the event of a national emergency, but it isn't disclosing how many additional tankers would be needed.

Because of the importance of adequate tanker transportation in time of emergency and the grave situation an indicated deficiency might imply if made known to a potential enemy, tanker requirements and indicated deficiencies are classified "secret" by the department.

However, it is not contended that if the Military Sea Transportation Service gets the 20 new supertankers it is seeking to procure on long-term charter, the 57 T-2 tankers currently operated by MSTS and the dozen now in the reserve fleet would meet all needs.

So far as tank cars are concerned, the department believes it is in good condition. The Interstate Commerce Commission reports about 116,000 serviceable petroleum-type tank cars in service while an undetermined number are currently employed in services other than petroleum, it is believed an emergency total of 89,800 general purpose and 15,200 pressure cars could be made available.

To meet the emergency requirements on the East Coast, the department has programed one major crude pipeline from the Texas Gulf Coast to the New York-Philadelphia area with a capacity of 540,000 bbl. daily and another to the Philadelphia-New York area from the vicinity of Lima, Ohio, with a capacity of 400,000 bbl. daily.

Unpleasant Position

One of these days Interior Secretary Douglas McKay may face the unpleasant necessity of declaring himself on restricting imports of foreign residual oil.

Right now, he's sitting on the fence hoping that time and the oil industry will take care of the problem before Congress gets around to it. Whatever position he takes, he will be accused of showing partiality to either the oil or coal industry and that's not good from either a political or scientific standpoint because the Interior Department is supposed to serve impartially all the resource industries under its jurisdiction.

To reach a decision the department must weigh the national security, the availability of coal and oil not only within the borders of the United States but in other key spots of the world, the effect of import restrictions on our foreign economic policy, and the impact of restrictions on the industrial centers of the eastern seaboard.

The coal industry already is sore at McKay because of the curtailment of work on synthetic liquid fuels and the reduction of funds for Bureau of Mines research, and Democratic members of Congress from the coal-producing states are making political ammunition of what they term the administration's abandonment of the coal industry.

Gas Hearing Set

Congress is now considering two natural-gas issues.

The subcommittee will hold hearings this week on what promises to be another fight, this to amend the Natural Gas Act to bar the importation of gas from Canada. Sen. Lester C. Hunt of Wyoming is sponsoring a bill which would require the FPC to consider importation of gas in the light of possible dislocation, unemployment or injury to competing domestic fuels.

A second gas issue also may be in the making depending upon the action of the Supreme Court in the Phillips Petroleum Co. case which involves the question of where the exemption of independent producers and gatherers from FPC control under the Natural Gas Act terminates. If Phillips is held to be subject to commission regulation, as indicated by the court's decision on the Texas gas-gathering tax, legislation will be sought to define the exemption provided by the act.

Because FPC officials felt they should not testify at this time, a Senate commerce subcommittee postponed for at least a month hearings scheduled for last week on Sen. Homer Ferguson's bill to limit the value of natural-gas company-owned reserves to no more than the actual cost to the company.

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The man being sought should be able to make quick contact with principals of major companies or independents on such an intimate basis that he has immediate entree at all times. He should be so well grounded in petroleum industry affairs that he has the ability to negotiate any type of deal, whether it be the purchase of producing properties, leasing, farmouts, a good exploration deal or whatever type of negotiation is at hand.

All information submitted will remain confidential. Applicants and their backgrounds will be thoroughly screened. Compensation of applicant will include the opportunity of sharing in profits of this prominent independent company. Send complete information about oil industry background and experience to Box No. H-194, The Oil and Gas Journal.

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TANKRETE Reinforced Concrete Bottoms are impervious to the corrosive action of sour or acid-type crudes — and installation cost is substantially less than for other types of bottoms. Maintenance expense is reduced to a minimum. These are the dollars-and-cents reasons why more and more oil companies — including Humble, Magnolia, Texas, Gulf, Shell and Phillips — are replacing an increasing number of steel bottoms with TANKRETE installations each year. As one official puts it: "Our cost records have shown us that TANKRETE Reinforced Concrete Bottoms are less expensive and more dependable than replacement with new steel."

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Demand Forecast Up

I.P.A.A. prediction is for 8,236,000 bbl. daily in 1954 with domestic demand up 3.8 per cent and exports down

DENVER.—Total petroleum demand is now expected to average 8,236,000 bbl. daily this year for an increase of 2.5 per cent over actual demand in 1953.

The Independent Petroleum Association of America also expects domestic demand to increase 3.8 per cent this year to 7,918,000 bbl. daily. A decrease of 20.7 per cent is forecast for exports of crude and products.

The forecasts were contained in a report prepared by the Supply and Demand Committee of the I.P.A.A. and presented here at the annual meeting of the association by H. B. Fell, chairman of the committee.

The current forecast of 8,236,000 bbl. daily for total demand represents a reduction of about 96,000 bbl. daily from the forecast made by the committee last October. Most of this downward revision resulted from low demands in the first quarter.

Total demand for the first 3 months of the year is estimated at 8,580,000 bbl. daily, based on Bureau of Mines figures for January and February and weekly A.P.I. figures for March.

Quarter forecasts . . . In the October forecast, first quarter demand was projected at 8,855,000 bbl. daily, based on normal weather during the quarter. The current estimate of actual demand represents a reduction of 275,000 bbl. daily from the original forecast with much of the loss due to warmer-than-normal weather.

Other revisions of the original forecast include a reduction of 55,000 bbl. daily in total demand for the second quarter, an increase of 25,000 bbl. daily for the third quarter, and a cut of 80,000 bbl. daily for the last 3 months of the year.

The new forecast also includes projections for the first quarter of 1955, making it possible to compare demand

TOTAL DEMAND BY SEASONS
(Thousands of barrels daily)

SUMMER QUARTERS

	1953	1954	Per cent change
Gasoline	3,598	3,697	2.8
Kerosine	210	198	—5.7
Distillate	1,077	1,105	2.6
Residual	1,540	1,423	—7.6
Other	1,178	1,395	18.4
Total	7,603	7,818	2.8

WINTER QUARTERS

	1953-54	1954-55	Per cent change
Gasoline	3,255	3,335	2.5
Kerosine	464	472	1.7
Distillate	1,839	2,052	11.6
Residual	1,703	1,722	1.1
Other	1,098	1,310	19.3
Total	8,359	8,891	6.4

ESTIMATED ADEQUATE INVENTORY LEVELS
(Millions of barrels)

	Crude	Products	Total
Mar. 31, 1954	271.0	421.5	692.5
June 30, 1954	275.0	444.0	719.0
Sept. 30, 1954	273.0	478.0	751.0
Dec. 31, 1954	270.0	455.0	725.0
Mar. 31, 1955	270.0	403.0	673.0

UNITED STATES PETROLEUM SUPPLY AND DEMAND FORECAST*
(Thousands of barrels daily, except closing stocks)

	1954					First quarter 1955
	First* quarter	Second quarter	Third quarter	Fourth quarter	Year	
Total demand:						
Gasoline	3,174	3,675	3,720	3,440	3,595	3,230
Kerosine	497	200	195	455	363	490
Distillate	2,059	1,160	1,050	1,845	1,539	2,260
Residual	1,746	1,465	1,380	1,670	1,565	1,775
Other products	1,104	1,315	1,475	1,315	1,174	1,305
Total	8,580	7,815	7,820	8,725	8,236	9,060
Exports:						
Gasoline	94	85	80	75	84	75
Kerosine	19	15	15	15	16	15
Distillate	55	75	65	60	64	60
Residual	66	55	55	50	56	50
Other products	67	55	55	50	57	50
Crude	40	45	40	40	41	40
Total	341	330	310	290	318	290
Domestic demand	8,239	7,485	7,510	8,435	7,918	8,770
Total stock change	—391	291	349	—283	—8	—578
Total new supply	8,189	8,106	8,169	8,442	8,228	8,482
Closing stocks (millions of barrels):						
Gasoline	183	162	142	154	154	173
Kerosine	19	28	38	29	29	17
Distillate	63	90	130	110	110	57
Residual	45	48	56	52	52	45
Other products and natural gasoline	111	116	112	110	110	111
Crude	271	275	273	270	270	270
Total	692	719	751	725	725	673
Runs to stills	6,984	6,929	7,067	7,173	7,040	7,165

*Estimated. Based on Bureau of Mines figures for January and February and A.P.I. figures for March.

SUPPLY
(Thousands of barrels daily)

	1954					First quarter 1955
	First quarter	Second quarter	Third quarter	Fourth quarter	Year 1954	
Imports:						
Crude	630	655	675	700	665	725
Products	490	375	350	505	430	530
Total	1,120	1,030	1,025	1,205	1,095	1,255
Production:						
Natural, etc.	690	665	686	709	687	699
Crude	6,379	6,411	6,458	6,528	6,446	6,528
Total	7,069	7,076	7,144	7,237	7,133	7,227
New supply	8,189	8,106	8,169	8,442	8,228	8,482

by seasons. These data are shown in the table of seasonal demands. Note that total demand this summer is expected to be up 2.8 per cent and that demand for the heating season is forecast at an increase of 6.4 per cent. The larger increase results from the fact that the past winter was warmer than normal while the forecast assumes normal weather for the coming winter.

Reduction in stocks . . . A reduction in crude and product stocks is forecast for 1954. The cut of 3,000,000 bbl. during the year represents a reduction at the rate of 8,000 bbl. daily in contrast with the increase of 148,000 bbl. daily in 1953. This net change of 156,000 bbl. daily influences the required supply for the year.

Since 148,000 bbl. daily of last year's supply went to build stocks and since 8,000 bbl. daily of this year's demand will come out of inventories, the required supply for 1954 will be only 0.6 per cent larger than last year.

The committee did not include a breakdown of supply in the principal forecast table but included the data in separate tables with limiting conditions.

Imports . . . Crude and product imports for the year were based on the import schedules reported to the Texas Railroad Commission by principal importing companies. Total imports for the year are forecast at 1,095,000 bbl. daily.

Production of natural-gas liquids is expected to average 687,000 bbl. daily for the year to increase to 699,000 bbl. daily for the first quarter of next year.

Crude production for the year is expected to average 6,446,000 bbl. daily unless there is a change in (1) anticipated demand, (2) indicated inventories, (3) scheduled imports, or (4) estimated production of natural-gas liquids.

The forecast of 6,446,000 bbl. daily for crude compares with 6,466,000 bbl. daily for 1953.

All demand and inventory figures are on the new basis which excludes jet fuel components from gasoline, kerosine, and distillate totals. Jet fuel is now included under other products.

ROCKY MOUNTAIN

Spacing Determined

North Dakota assigns limits to four pools

BISMARCK, N. D.—Applications for temporary 80-acre spacing were granted for three oil pools and denied in a fourth by the North Dakota Industrial Commission.

The orders were signed by Gov. Norman Brunsdale and Math Dahl, secretary of agriculture and labor. The third member, Elmo Christianson, has resigned following his conviction and sentence for consipiring to bring gambling devices into the state in violation of federal law.

Gov. Brunsdale had appointed Paul Benson, Grand Forks attorney, to serve the remaining 7½ months of Christianson's term. Benson, 35, was a member of Sen. Milton Young's staff at Washington prior to practicing law at Grand Forks the past 5 years.

Madison pools in Charlson field, McKenzie County, Hofflund in Williams County, and White Earth in Mountrail County were granted 80-acre spacing while the Fryburg sand pool in Billings County was set at 40 acres. The orders are in effect for 12 months in Charlson and Hofflund while the others were set at 18 months.

Performance of the discovery well in the Fryburg sand indicates it will not inspire a drilling program other than as salvage oil supplementing the main pay in the Madison lime. Amerada Petroleum Corp., and the Northern Pacific Railway completed the 1 Cheadle unit, SW NW 9-139n-100w, in the sand when it was unproductive as a Madison producer.

C. V. Millikan, Amerada engineer, testified at the hearing that the well probably cannot produce more than 75 bbl. daily although entitled to a discovery allowable of 200 bbl. completed at 8,271-8,278 ft., its initial production after fracturing with 2,000 gals. was 117 bbl. of 31.2°-gravity oil, flowing 24 hours through open 2-in. tubing.

Originally labeled the Heath sand of Mississippian age, the reservoir now is being called Minnelusa in the Pennsylvanian.

Socony High Bidder

NEW TOWN, N. D.—Socony-Vacuum Oil Co. was high bidder on oil and gas leases on eight tracts of alloted Indian lands offered by the Fort Berthold Reservation Agency.

Socony bid $250,926, or $201.26 per acre for 800 acres in five tracts, and $101.26 per acre for 888 acres in three other tracts.

Stanolind Oil & Gas Co. was second high with bids as high as $51.68 an acre for 1,599 acres.

Gas Area Extended

Pictured Cliffs gas well extends field 12 miles

FARMINGTON, N. M. — Southern Union Gas Co. has extended its Pictured Cliffs gas production 12 miles east of previously established areas with an important strike in Rio Arriba County.

The well, 2-A Jicarilla, gaged 4,068 M.c.f. of gas per day with tubing pressure of 987 psi., a new high for the area. Some estimates rate the well at more than 10,000 M.c.f. per day.

The same firm is drilling a second wildcat southeast of the new discovery. The Jicarilla extension indicates the eastern limits of the Pictured Cliffs sand reserve in the San Juan basin are anything but established.

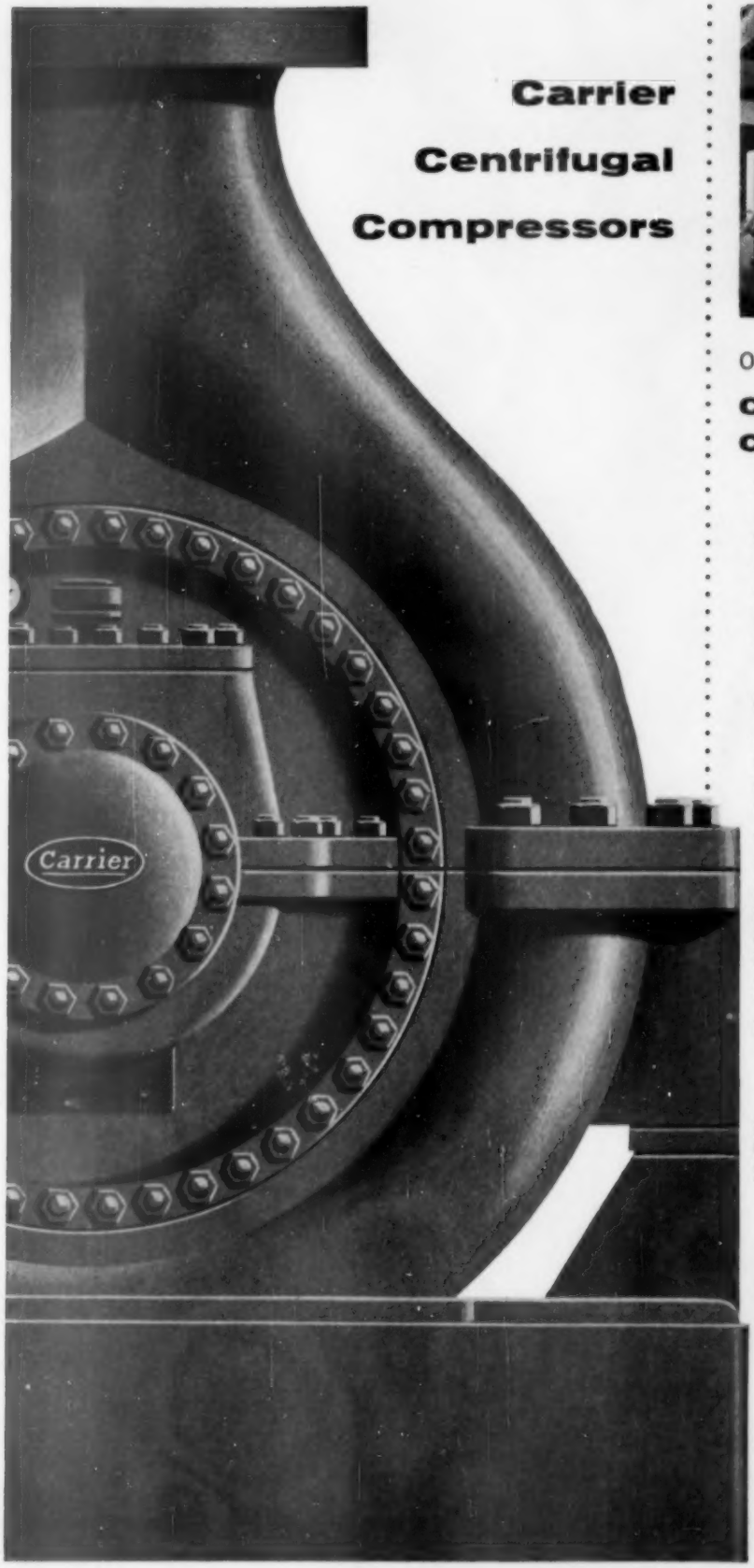
Ethics Code Voted

North Dakota association endorses geophysical rules

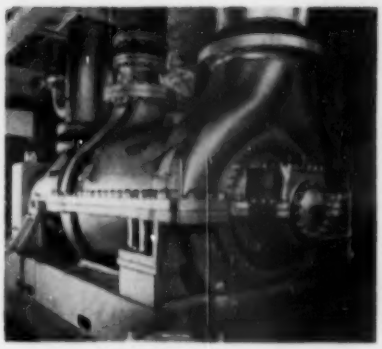
BISMARCK, N. D.—A 13-point operational code of ethics for geophysical exploration has been adopted by the North Dakota Oil and Gas Association.

The code is designed to safeguard property and is being circulated among farmers, ranchers, and other landowners as a guide for what to expect when geophysical work is done by companies who are members of the association. A 16-man committee, headed by O. H. Armstrong, Bismarck, of Socony-Vacuum Oil Co., Inc., developed the code.

The code prohibits exploding powder charges within one-eighth of a mile of any water well, spring, reservoir, dam, or dwelling without permission of the owner. Use of bulldozers is prohibited without the landowners consent. Carrying firearms and fishing on the land also will not be permitted.



Carrier Centrifugal Compressors



on the job at

Continental Oil Company

This Carrier Centrifugal Compressor is on the job at the Continental Oil Company's plant at Billings, Montana. It is the main air blower for the fluid catalytic cracking unit. It handles 25,000 cfm of air and operates at 4520 rpm.

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Japan's Imports Shaky

Heavy fuel curbs adopted; firms without foreign tieups are contacting several countries in effort to buy crude

THE Japanese oil industry is running into increasing difficulty as a result of the country's shortages of foreign exchange.

Measures curbing the consumption of heavy fuel oil have been worked out by the Ministry of International Trade and Industry and approved by the cabinet. Originally, it was also planned to cut back use of gasoline, but enforcement of these steps was postponed in the face of strong opposition of the Transportation Ministry.

Refining and marketing companies not affiliated with large foreign companies are seeking to import crude through barter arrangements or by tieups with foreign interests. Idemitsu Kosan made a series of controversial shipments from Iran last year and hopes to resume these purchases as soon as a British-Iranian settlement is reached. Idemitsu recently contracted with Gulf to import Venezuelan oil, according to Tokyo reports, and the first shipment was scheduled to reach Japan the end of April.

Daikyo Oil Co., which bought the first tankerload of crude exported from the Kuwait-Saudi Arabia Neutral Zone last January, also is looking hopefully toward the Iranian National Oil Co. as a possible future source of crude oil. The company is reported to have sought government approval for a plan to barter Japanese goods for Iranian oil.

Also reported to be interested in importing Iranian oil is the Mitsubishi Oil Co. Its efforts to obtain Iranian oil are being made through the Tozai Koeki Co. in Tokyo, which is planning to sell sugar refining plant equipment to Iran.

Other countries studied . . . Besides these proposals dealing with Iranian production, Nippon Mining Co. is studying the development of oil production in Atjeh, Sumatra, jointly with Indonesian interests. This company has already finished a field survey of the possibilities of the undertaking. Atjeh is the North Sumatra area where Royal Dutch-Shell operated producing and refining properties prewar. The installations were taken over by local Indonesian groups, and Shell has been denied access to the region.

Various other nonaffiliated Japanese importing and marketing companies have been working on plans to import oil under barter arrangements with several other countries, including Soviet Russia. Reports from Tokyo are that Okura Trading, Tokyo Bussan, and Ito Chu Oil Co. are interested in Russian oil: Daiichi Bussan, in Iranian, Iraqi and Mexico oil; Meguro Oil Co., in Mexican oil, and Takashimaya - Iida Trading in Canadian oil. Both Fuji Commercial Co. and Tokyo Trading Co. are attempting to work out deals to purchase crude from Iraq.

Prospects dim . . . For one reason or another, most of these proposed importing deals probably will fail to materialize. Most of them undoubtedly were given encouragement by Idemitsu's series of shipments of Iranian products last year. Idemitsu's actions had repercussions in Japanese-British relations and the company is defendant in a still-pending lawsuit by Anglo-Iranian Oil Co., Ltd.

In common with the rest of Japanese industry, the shortage of exchange to buy raw materials is a major problem of the Japanese oil industry. Japanese consumption in 1953 was estimated at 133,000 bbl. daily, and 95 per cent of the requirements are imported, mostly in the form of crude. About three-quarters of the crude imports come from the dollar area, and the remaining one-fourth from the sterling area.

Up to now, Japan's economy has been sustained by American assistance in one form or another, but this is tapering off. Japan had an over-all trading deficit of about £50,000,000 in its sterling account in the year ended March 31. The dollar account dropped $140,000,000 in the second and third quarters of last year.

Drilling Pact Made

Pantepec to explore Israeli acreage for two companies

PANTEPEC OIL CO., C.A., has entered into drilling and operating agreements covering acreage held in Israel by two recently organized companies, Pan-Israel Oil Co., Inc., and Mediterranean Petroleum Corp., Inc.

The two companies hold exploration licenses on about 800,000 acres in Israel. Pantepec has agreed to conduct a shallow core-hole program and to drill three exploratory wells for each company at cost plus administrative overhead.

In consideration, Pantepec will receive voting trust certificates in the two companies, all geophysical and geological data on the properties, and options to earn 50 per cent interest in each license by assuming the drilling expenses as well as stock purchase options. The drilling will be by Pantepec's subsidiary, Tri-Continent Drilling Co., Inc.

70,000-Bbl. Refinery Changing Freemantle Skyline

Anglo-Iranian Oil Co.'s 70,000-bbl. per stream day refinery at Freemantle is about 30 per cent completed. When finished the refinery will furnish the equivalent of nearly half the country's petroleum needs. Facilities will include two 35,000 bbl. distillation units and a 12,500-bbl. Orthoflow fluid cat cracker. Kellogg International Corp. is supervising construction.

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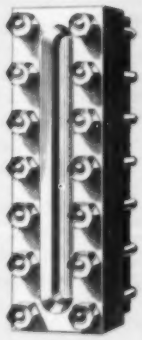

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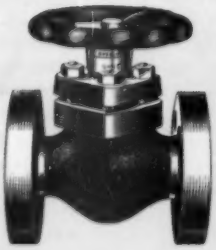

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Aden Refinery Transforms Barren Site

This aerial view illustrates the transformation that has been made during the last 2 years at the site of the new 120,000-bbl. daily refinery of Anglo-Iranian Oil Co., Ltd., near the port of Aden at the southern tip of the Arabian Peninsula. The project is the largest complete refinery now under construction. More than 14,000 men, including 2,500 Americans, British, and European technicians, are working to complete the $150,000,000 undertaking by the end of the year. The two main process units shown here are the crude units, left, and the Platforming unit. In front of these units are the autofiner and the SO_3 plant. (An Anglo-Iranian photo).

Settlement Predicted

Iranian Government says negotiators nearing agreement; predicts early pact to return Iran's oil to world market

AN early and successful conclusion to the Iranian oil negotiations now taking place in Teheran is being predicted by Iranian Government officials.

Negotiations have been under way since April 14 in Teheran between a delegation representing the newly formed eight-company international oil consortium and Iranian Government leaders.

The discussions are aimed at a long-term lease agreement under which the consortium will reactivate Iran's oil industry which has been virtually idle since it was nationalized nearly 3 years ago.

An Iranian Government statement issued early last week after the eighth meeting of the parties said the two sides are near agreement. The most recent meeting concerned the method of management of the properties.

Settlement soon . . . At the same time, Iranian Finance Minister Ali Amini, head of the Iranian Government negotiating group, predicted a general settlement of the problem by the end of the week. It was not specifically stated whether this included the auxiliary negotiations taking place directly between British and Iranian officials on the question of compensation for Anglo-Iranian Oil Co., Ltd.

General Zahedi, the Iranian prime minister, has again given assurances that the 1951 Iranian nationalization law would be respected in the final settlement. These assurances were made to the Iranian Senate which gave the government a vote of confidence 39-1 with 5 abstentions.

Although the talks have been conducted in complete secrecy, reliable reports have indicated in general the nature of some of the terms of the likely agreement. The operations will be under a form of foreign supervision, and Iran will retain a minor share of the production to sell independently. Total output is expected to be limited to the normal increase in Eastern Hemisphere demand, and the consortium's lease will run to the end of 1993, the year of expiration of the old Anglo-Iranian concession.

Cuban Discovery

Well drilled by Kermac flowing 192 bbl. daily

A LOCAL Cuban group has brought in what promises to be the first important oil production in the country.

The well, Echevarria 1, situated about 3 miles northwest of the town of Hatibonico in west central Cuba, was completed flowing 8 bbl. an hour, or at a rate of 192 bbl. daily, on a 5/8-in. choke from perforations between 1,072-1,088 ft. Gravity of the crude was around 30°. Seven-inch o.d. pipe was set at 1,850 ft., and 64 shots were made in the interval.

The well was taken to a total depth of 8,375 ft. as the first deep test ever drilled on the island by Cuban independents. Drilling was by Kerr-McGee Oil Industries, Inc., personnel using a Cuban-owned National 75 rig. Kerr-McGee acquired an option to take a 25 per cent interest in the operation in return for drilling the well at cost.

Two other tests were made, one between 1,304-20 ft. and the other around 1,600 ft. The well was completed at the shallower interval after field personnel improvised a coke and well-head equipment. There was only a small amount of gas with the oil flow.

Significance . . . Significance of the discovery is crude was coming from igneous clastics believed to be Upper Cretaceous in age. Cuba's existing production, amounting to less than 100 bbl. daily from two other old fields, comes from nonsedimentary serpentine rocks and consists of a light distillate-type oil.

The Echevarria well was backed by Cuban interests organized as the Jarahueca Group and headed by Antonio Iglesias, a Havana attorney.

The group holds rights to a 27,000-acre block in which the well is located. The same group owns a small topping plant in the old Jarajueca field. This plant was recently expanded to about 1,000 bbl. daily capacity with the assistance of Kerr-McGee. It has been using imported crude trucked from Havana plus the minor indigenous production from the older fields.

Only other drilling of consequence in Cuba in recent years was by Cuban Gulf Oil Corp. which put down two unsuccessful tests off the north coast of the island. Gulf has recently been reported planning to resume exploratory work in Cuba.

Several major companies have undertaken intermittent exploration in Cuba since the turn of the century, but none of these tests has shown tangible results.

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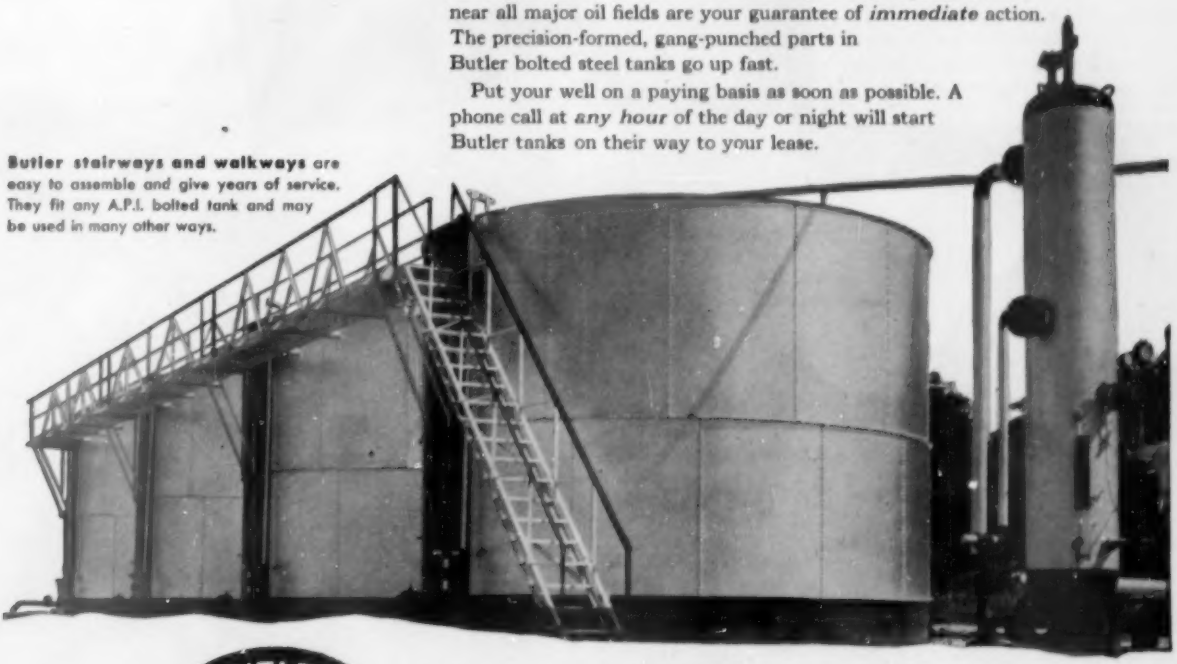

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T.G.T... 10 Years Later

. . . A special section relating progress of Tennessee Gas Transmission Co. since its start in 1944, and forecasting natural-gas development during the next decade

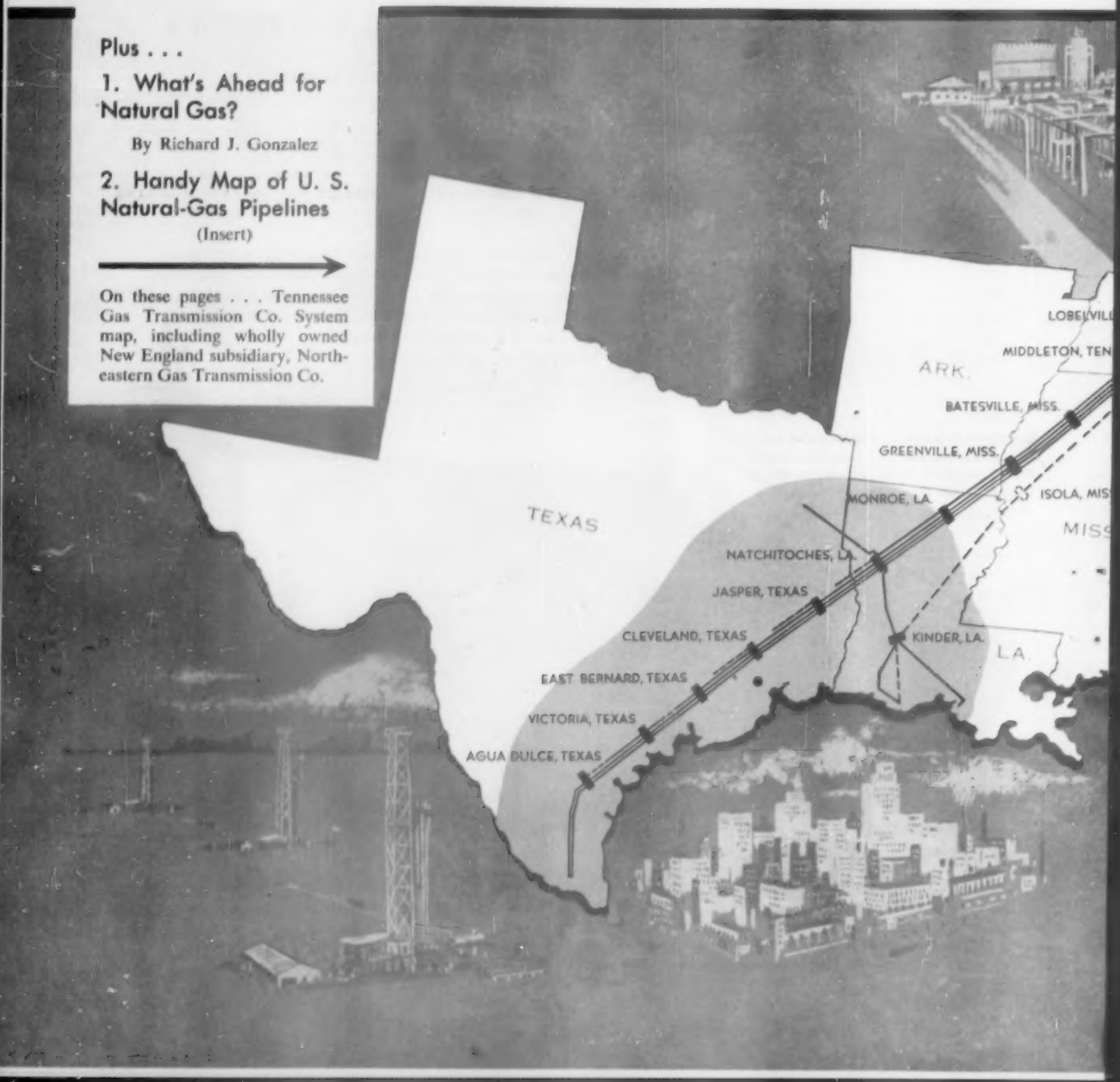
Plus . . .

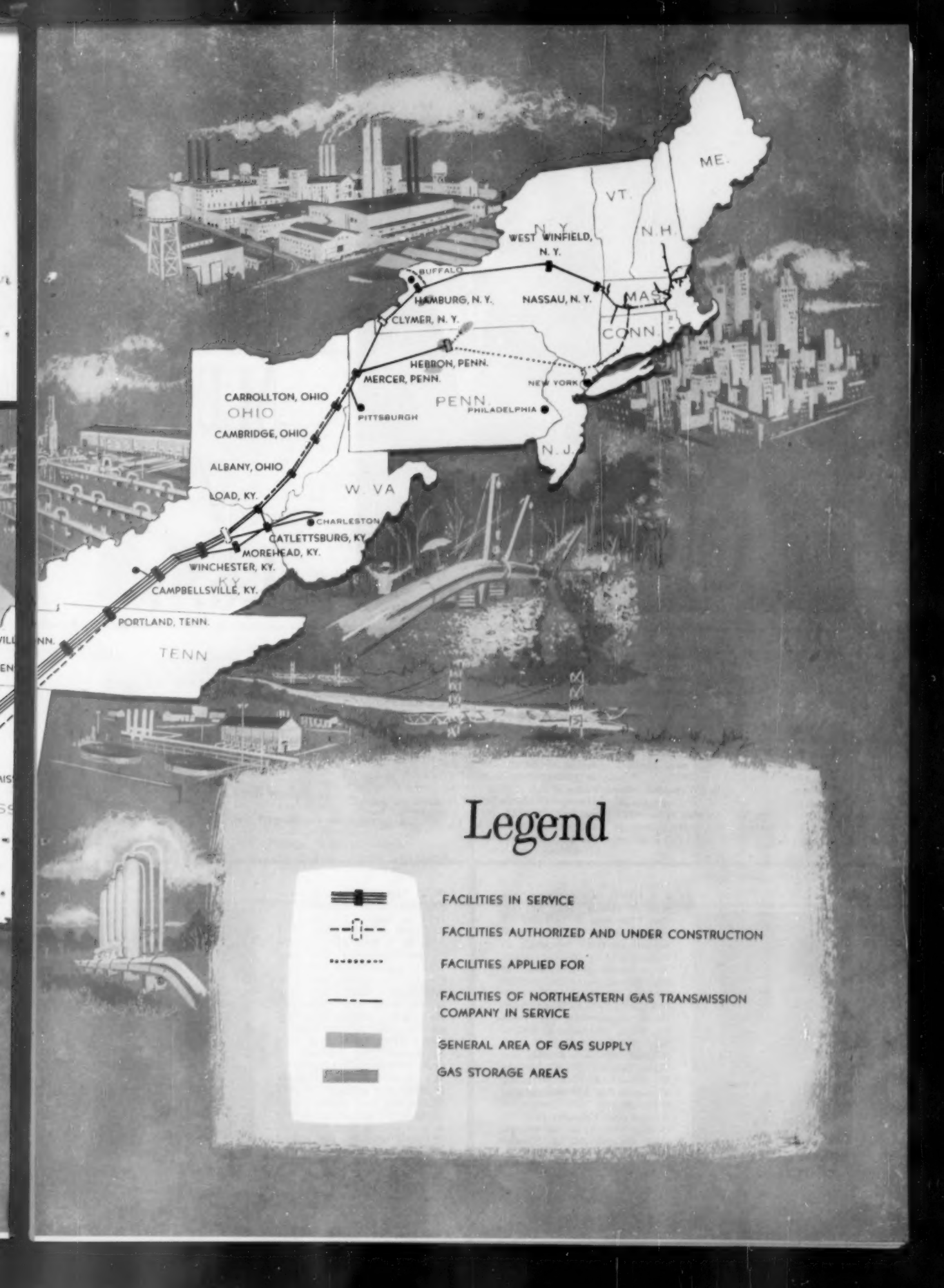
1. What's Ahead for Natural Gas?

By Richard J. Gonzalez

2. Handy Map of U. S. Natural-Gas Pipelines (Insert)

On these pages . . . Tennessee Gas Transmission Co. System map, including wholly owned New England subsidiary, Northeastern Gas Transmission Co.

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GENERAL AREA OF GAS SUPPLY
GAS STORAGE AREAS

The MEN *of* T.G.T.

GARDINER SYMONDS is president and director of Tennessee Gas Transmission Co., which has its headquarters in Houston, where Symonds makes his home. This company owns and operates the nation's longest natural-gas pipeline system which stretches 2,200 miles from South Texas to New England.

Symonds has headed the company as chief executive officer since its formation in 1943. Prior to that time he was a vice president and director of The Chicago Corp.

In adition, Symonds is board chairman and president of two Tennessee Gas subsidiaries: Northeastern Gas Transmission Co., which operates a natural-gas-transmission system in New England, and Tennessee Life Insurance Co., of Houston. He is also chairman of the board of Tennessee Production Co., an affiliated oil-producing company.

He is a director of General Telephone Corp., General Public Service Corp., Mathieson Chemical Corp., American Republics Corp., and the National Bank of Commerce of Houston.

Symonds was born in 1903 in Pittsburgh and reared in Chicago. He received a B.A. degree in geology from Stanford University in 1924 and a M.B.A. degree with distinction from the Harvard Graduate School of Business Administration in 1927. He is a trustee of Smith College, Northampton, Mass., and of St. John's School, of Houston.

• • • These are the men who have directed the progress of one of the nation's leading gas-transmission companies. In the articles which follow they tell of the past and attempt to foretell the future.

J. J. KING, vice president, was born in Moody, Tex., July 15, 1901. He has a bachelor of science degree in mechanical engineering from University of Texas and is a graduate of South Texas School of Law. Prior to 1940 he was compressor-stations superintendent, United Gas Pipeline Co. In 1940 he became consulting engineer for The Texas Co. From November 4, 1942 to July 1, 1945, he served the Army as Chief, Petroleum Branch, War Plans Division, in Washington. On March 16, 1946, he joined Tennessee Gas and was assistant superintendent of compressor stations until February 1948. On October 18, 1949, he became chief engineer and on November 12, 1951, vice president.

W. C. McGEE, JR., vice president, was born September 14, 1910, at Dodd City, Tex. He graduated in 1931 from Texas A. & M. College with a degree in civil engineering. The same year he joined Northern Natural Gas Co. as engineer, serving in that capacity until 1937, when he was made chief dispatcher. He held that position until August 16, 1944. At that time he joined Tennessee Gas as chief dispatcher. On February 1, 1946, he was made assistant to vice president, and on January 1, 1948, chief engineer. In 1949 McGee was made general superintendent of operations, serving in that position until November 12, 1951, when he was elected vice president.

A. L. STEGNER, corrosion and communications superintendent, was born in Cleveland in 1905, and received bachelor degree in electrical engineering at Louisiana State University. He was engineer, 1928-1941, for several organizations: Alabama Power Co. (designing and constructing high - voltage equipment), State Highway Department of Louisiana, and with a consulting engineering firm. During World War II he was colonel under Gen. George Patton. In April 1946 he joined Tennessee Gas as cathodic engineer. He was president in 1951 of the Petroleum Industry Electrical Association.

O. H. MOORE, director of operating research, was born in Fort Worth in 1902 and educated at Texas A. & M. College, where he received a bachelor of science degree in mechanical engineering in 1926 and a professional mechanical engineering degree in 1940. He joined Lone Star Gas Co. as a cadet engineer in 1926. In 1929 he became assistant compressor superintendent of that company, a position he held until 1943. On November 16, 1943 he joined T.G.T. as compressor - station superintendent, and organized its compressor department. He headed the department until 1951.

EDWARD S. MURRAY, chief engineer, born in Denver June 4, 1894, has the degree of bachelor of science, mechanical engineering from Colorado A. & M. Experience in the oil and gas industry includes: Midwest Refining Co., Wyoming, 9 years; Marland and Pure Oil Co.'s, Oklahoma, 1 year; International Petroleum and Tropical Oil companies, South America, 9 years; Northern Natural Gas Co. and Natural Gas Pipeline Co. of America, 4 years. He joined T.G.T. November 27, 1943 as design engineer and has been construction, supervising, and assistant chief engineer.

SAM C. OLIPHANT, vice president of Tennessee Production Co., was born November 9, 1916, at Harrisonburg, La. Education includes bachelor of science, petroleum engineering 1938, master of science degree 1941, both from University of Texas, and advanced management course at Harvard Business School, 1951. He was research chemist at Dow Chemical Co. 1938-1939; junior engineer, petroleum engineer, field engineer, district engineer, district superintendent and assistant division production superintendent, Stanolind Oil & Gas Co., 1941-1952. He joined Tennessee Production December 16, 1952.

R. V. MERTZ, compressor superintendent, born at Lake Arthur, N. M. in 1907, holds degrees of electrical engineering from Oklahoma A. & M. College, and B.S. and M.S. in chemical engineering from University of Oklahoma. He was junior engineer for Phillips Petroleum Co. 1930-1935, fractionator superintendent 1935-1938, chemical engineer 1941 - 1942, superintendent of operations of Borger plant 1942-1944. From 1944 to 1946 he was chief chemical engineer, Mid-Continent Engineering Co., Dallas, and mechanical engineer and group leader, Stanolind Oil & Gas Co. 1946-1950.

EDWARD S. PLANK, superintendent of gas measurement, was born February 27, 1901, at Grove, Okla., and educated at Oklahoma University and Kendall College, predecessor of University of Tulsa. He served from 1931 to 1936 as gas-measurement engineer for Northern Natural Gas Co. Plank joined Tennessee Gas as measurement engineer on September 10, 1944, while the original line was under construction. He became assistant measurement superintendent January 1, 1948. He took his present position August 1, 1948.

T. K. DAVIS, superintendent of gas control, was born October 3, 1917, at Kenton, Ohio, and was educated at Northwestern University and University of Houston, from which he received a bachelor of business administration degree in engineering management. He was a dispatcher for Northern Natural Gas Co., from 1937 to 1942. He joined Tennessee Gas Transmission Co. May 1, 1946, as a dispatcher, and on January 1, 1951, he was elevated to his present position.

TONY ZUMA, aviation manager, was born in Bryan, Tex., in 1918, and educated at University of Houston. From 1937 to 1940 he was president of Aero Service Co. In 1940 he was pilot instructor, Dallas School of Aviation, and in 1941 was pilot instructor Brady School of Aviation. While an Air Corps officer, 1941-1945, he was director of flying safety, Air Transport Command; commanding officer, 55th Engineering Group, and air inspector, 555th AAF B. U. He was a major when placed on inactive duty. He joined Tennessee Gas October 21, 1945, as pilot. On January 16, 1953, he became aviation manager.

OVERHEAD CROSSING . . . Bridge across the Mississippi River near Greenville, Miss. At lower left can be seen the expansion joints for the four 26-in. T.G.T. pipelines which cross the river on the bridge.

UNDERWATER CROSSING . . . Natural-gas-transmission companies cross rivers below surface as well as overhead. Here is where Tennessee Gas crosses the Red River by means of an underwater crossing.

A Look at 1964... *A Forecast*

T.G.T and the Natural-Gas Industry 10 Years Hence

by Gardiner Symonds

A MILESTONE has been reached by Tennessee Gas Transmission Co. with completion of 10 active and growing years as a company, during which time it increased the capacity of its natural-gas pipeline system more than seven times and its compressor horsepower more than eight times.

Accordingly, there may be some value at this point in attempting some general forecasting as to what the future may hold in the next 10 years for both the company and the dynamic natural-gas industry of which it is a part.

Tennessee Gas, on the basis of past growth, present status, and future plans and prospects, may be expected to double its facilities within the next decade.

Industry to Keep Growing

The natural-gas industry, likewise, in the next 10 years will continue the expanding trend which in the past 10 has brought it wide recognition as possibly the fastest-growing industry in the nation. It is not anywhere near its peak.

The transmission phase of the industry, in particular, has great growth possibilities because the pipeline is the low-cost, efficient transporter of fuel for any distance, but especially for long distance.

Not that the advantages of natural gas stop at the end of the transmission line, of course. It is easier and more convenient for the gas-distribution company to deliver its product than for dealers of competing fuels to deliver theirs. Somebody, at the consumer's home, has to clean up after the truck or around the coal chute.

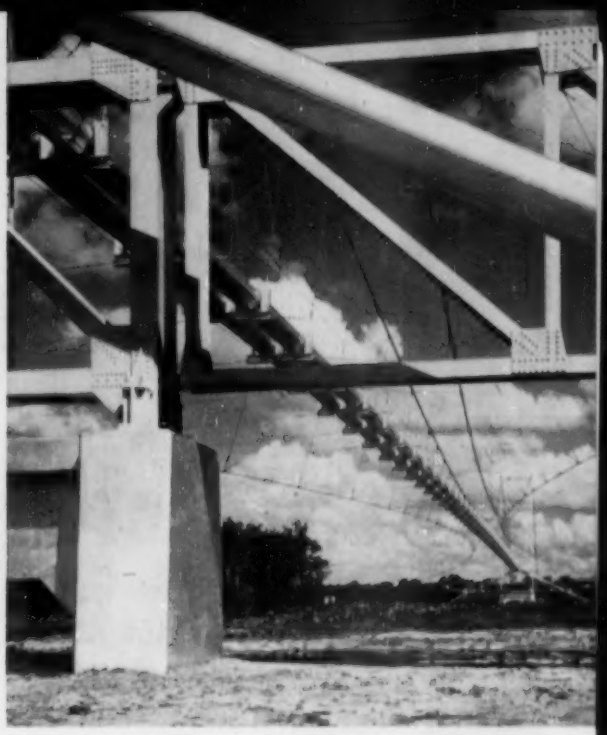
This is not the place for a dissertation on the many advantages of gas at the point of consumption, the home, place of business, or industry. The advantages are such that, long after disappearance of all other waiting lists of the American public for products or services, such as autos, telephones, and the other things we formerly waited for, waiting lists exist bearing thousands of names of persons who want natural-gas service to their homes.

The point is that this public preference for gas means no end is in sight to the natural-gas industry's growth. There will be growth in the amount of energy that the public will use in this nation to make it a better place in which to live, and the industry is going to take on an increasing proportion of that total energy requirement.

The industry's expansion, obviously, must come out of the growth of the country and its population, or out of competing fuels. It probably will come both ways.

Coal probably will continue to bear the brunt of the gas industry's expansion at expense of competing fuels. Coal in 1900 furnished nearly 90 per cent of the nation's primary energy; in 1953 it furnished only 32.3 per cent, or only 9.2 per cent more than

OVERHEAD CROSSING of Red River in Louisiana, with the two pipelines being shown in the foreground.



SUSPENSION BRIDGE, one of two constituting T.G.T.'s double aerial crossing of the Brazos River in Texas.

natural gas. Natural gas has been gaining on coal for a long time but has been narrowing the gap in a hurry in the past 10 years, and a few more years should see natural gas overtake coal and challenge oil.

Gas May Overtake Oil?

It has even been predicted within recent weeks that gas would overtake oil as leading supplier of national energy. It is possible, certainly, but not for several years. We may look for increasing competition between natural gas and oil for markets, and it should be a healthful thing for both, tending to result in gas being used as it should be used, as a superior fuel and oil also being used for purposes for which it is best and most naturally suited.

Growth of the gas industry in the next decade will be of a different kind from that of the last 10 years. The race to extend service into regions not served is about over, with only the Pacific Northwest unserved and a Federal Power Commission decision expected before too long for that area.

Future growth will be growth in depth. That is, new customers will be added in markets now served by gas, and new services added for existing natural-gas users. Chief of these is house heating, but air conditioning, clothes drying, cooking, and water-heating loads will be added in a great many cases.

Coal and oil are cheaper on a strictly B.t.u. basis on the eastern seaboard at present and prospective prices. Coal is not hard to displace, however, for domestic and apartment-house heating and other purposes.

An example of such a growing market for domestic heating is the New York metropolitan area. To serve additional customers there, facilities would need to be expanded for increased capacity at an average rate of 150 million cubic feet daily each year for the next 10 years.

Incidentally, if the application of Tennessee Gas to become an additional supplier of this market is granted as expected, the company will be in a strong competitive position to take on much of the growth of this large market as it occurs. This is because of adjacency of the company's projected underground storage fields, comparatively low-cost factors built into its multiple-pipeline system, and of the strategic location of its 1,000-mile loop of pipeline through which gas could be delivered to this major market from either of two directions.

The field price of natural gas is an extremely complicated subject. For many years it was too low, held down by regulation of gas prices at distribution and transmission levels, while prices of competing unregulated fuels rose sharply.

As a result conservation suffered and land and royalty owners and producers in producing states were penalized. It was not economically feasible to gather, process, and market casing-head gas from many oil fields, so trillions of cubic feet of it was flared and lost.

Consumers appeared to benefit from low rates, but the advantage was more apparent than real. Part of the supplies which should have remained for their future use was wasted; and low field prices gave no incentive to build up dependable supplies for their use.

Construction of new long-line natural-gas systems and expansion of existing ones played a major and much unsung part in improving this situation. They gave a market at improved prices for gas in shut-in fields, as well as for casing-head gas, thus making it possible for state regulatory bodies, especially those in Texas and Louisiana, to issue enforceable orders and practically eliminate flaring.

They provided an incentive for producers and drillers to hunt for gas, thus helping firm up long-range, dependable supplies for consumers.

Tennessee Gas prices, paid for gas in the field, for example, averaged 9.5 cents in 1953. This was almost double the 4.6 cents per M.c.f. paid 4 years earlier, in 1949. And the company's prices still are rising.

There have been advantages accruing from field price increases in the past. But the time is fast approaching when producers must recognize limitations on further increases.

Factors with a tendency to flatten the curve of rising field prices are several. Gas on the eastern seaboard no longer is the cheapest fuel in the market on a strict B.t.u. basis. Frankly, this is good, for it is superior fuel and should be sold as such.

MAKING UP PIPE in Louisiana during the 1953 construction program of T.G.T.

T.G.T. . . . 10 Years Later

New gas pipelines of the promotional type seem to be declining in number. Reserves of natural gas in Canada and Mexico, neither of which has sufficient home markets to utilize them, will begin to bulge over into the United States with a tendency to place a ceiling on field price escalation in this country.

Tennessee Gas, by the way, may well be handling large amounts from Canada, or Mexico, or both in the next 10 years. Location of the company's pipeline system within a few miles of both countries places the company in a strategic position if reserves from either country become available.

In considering Mexican and Canadian gas, prices are interesting. If gas cost 12 cents at the Rio Grande, for instance, a transmission line after transporting it to New York State would have to charge 40 to 45 cents for it. On the other hand, to make the Canadian West-East pipeline feasible without subsidy its operators must sell big volumes of summer gas to be used for storage, and it is estimated they can deliver it for 37 cents per M.c.f. at the Niagara River.

On that basis, Mexican gas or even Valley gas would be at a competitive disadvantage with gas from Canada. But time must pass before the exact picture becomes clear.

Meantime, Niagara Gas Transmission, Ltd., an affiliate of Tennessee Gas, is at work obtaining the necessary Canadian authorization to build the Canadian leg of a line for delivery of Gulf Coast gas to Toronto. Tennessee Gas would haul the gas, which it has bought on the Gulf Coast, to the Niagara River on the international boundary.

We would anticipate no trouble in initiating service to Toronto, since the buildup of that service is highly important to Canadian pipelines, when and if built, and we are in position to work closely with and integrate our plans with any Canadian program adequately sponsored. By 1960 or earlier, instead of delivering to Toronto, the Niagara Gas pipeline may well be picking up Alberta gas and delivering it to Tennessee Gas for storage.

Gas Reserves

In addition to the Canadian and Mexican gas, reserves here in the United States continue to be found in volumes enough to take care of mounting production and still yield a substantial net gain. In 1953, United States proved recoverable reserves rose from less than 200 trillion to 211.4 trillion, over and above production.

Gulf Coast reserves, of particular interest to Tennessee Gas since nearly all the company's pipeline gas comes from there, are ample for programs in sight and prospects are good for continued increase on a large scale. The recently announced estimates of 30 trillion cubic feet of undedicated reserves on the Gulf Coast are in my opinion too conservative.

Gas from the tidelands will come on the market. And the feeling is general in the industry that major gas production is more probable here than major oil production. The nature of the structures on exploration work done to date indicates that while both gas and oil will be found, the vapor phase will be more persistent. What lies in the tidelands is to a great extent unknown; but producers are pouring money into leases and equipment to find out. Structures there appear to be as good as those on shore.

And only one-third of the depth of the Gulf Coast sediments has been explored. In 10 years they probably will be drilling gas wells down to 25,000 ft., though progress in deeper drilling depends to some extent on development of metallurgy in that period.

Some of this deep exploration may not be economically justified, however, until crude oil sells for a lot higher price and natural gas commonly sells for 15 cents per M.c.f.

Reserves of T.G.T.

Tennessee Gas has been aggressive in acquiring gas reserves throughout the company's first 10 years, and plans are for more rather than less intensive activity along this line in the next decade.

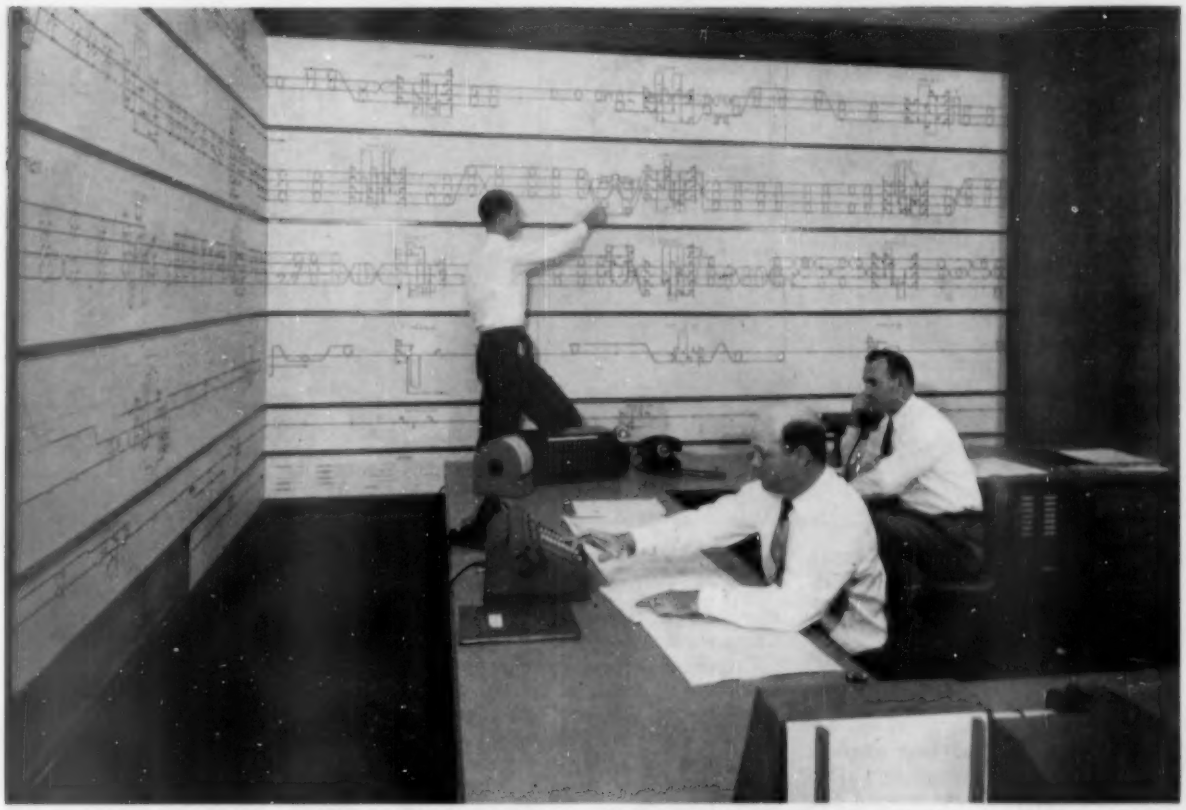
The company ended 1953 with more than 12 trillion cubic feet of gas under contract. Some 10 years ago the company began operating with a 20-year supply for a 200-million-cubic-foot program. Now it has a 20 to 25-year supply for a 1.5-billion daily throughput.

Considering the company's rights to take gas, or the field's ability to produce, whichever is smaller, and adding our contracts all together, total withdrawal rights total 3 billion cubic feet a day. Of course, line capacity is not sufficient to take that much now.

Underground Storage

Perhaps the greatest of the several opportunities for future expansion of the natural-gas industry is that of house

(Continued on page 117)



GAS CONTROL DEPARTMENT at Houston. Dispatcher in foreground totals gas sales for a report. An engineer, seated, right, acting as assistant dispatcher, takes a reading from a gas-purchase location from a supplier. An engineer, standing, posts a change on the map.

Five-State Loop Will Bring Important Dispatching and Operational Advantages

Double manifolding and major underground storage in forefront

by W. C. McGee and T. K. Davis

THE 1,000-mile, five-state pipeline loop, already three-fourths constructed, which Tennessee Gas Transmission Co. proposes to complete to give the New York City metropolitan area a new source of gas supply, promises great advantages from an operational and dispatching standpoint.

The loop would be completed with proposed construction of a 243-mile pipeline from the company's Hebron storage field in North Central Pennsylvania southeast across Pennsylvania, New Jersey, and New York State to near Greenwich, Conn., where it would connect with the system of the company's New England subsidiary, Northeastern Gas Transmission Co.

It would form the south arc and complete a 1,000-mile pipeline loop in New York, Pennsylvania, New Jersey, Connecticut, and Massachusetts. The loop would begin and end near the Ohio-Pennsylvania state line at the company's No. 219 compressor station at Mercer, Pa.

It would be located at the delivery end of the company's multiple-line transmission system which runs northeast from the Gulf Coast. An unmatched flexibility and dependability of service would be afforded the company's customer distribution gas companies on the loop—and to those firms' millions of customers in homes, business places, and industries.

Flexible operations . . . Two different types of installations along this big Tennessee Gas pipeline circle would be the chief causes of these advantages, which loom so large in the thinking of men in operations and its important division, dispatching.

1. Six compressor stations, including four already on the line and two more included in company 1954 construction plans, can all be double manifolded, making it possible when desirable to pump gas in either direction. Thus, to any point on the loop, gas could be pumped from either side.

2. A major underground storage program, including ultimate development jointly with other firms of five storage pools tied into the pipeline loop, constitute another key phase of the project.

The five are Hebron, near Coudersport, Pa., already undergoing gas in-

jection; Colden, near Buffalo, N. Y., and Harrison, in North Pennsylvania, for which near-term development is planned; and State Line and Ellisburg, both in Pennsylvania, somewhat more long-range.

With a total of 77 billion cubic feet of top storage, or a daily deliverability of 770 million per day for 100 sustained days, these underground savings banks for natural gas should within practical limits insure ability to supply customers' requirements, even in the face of some excess demand or in the unlikely event of mechanical failure on the transmission system.

Engine manifolding . . . The program calls for double-service compressor engine manifolding immediately at Station 219, Mercer, Pa., where the loop begins, and at Station 313, Coudersport, Pa., beside Hebron field. This manifolding will permit the natural-gas stream coming from the Southwest into the Mercer station to be divided into two streams.

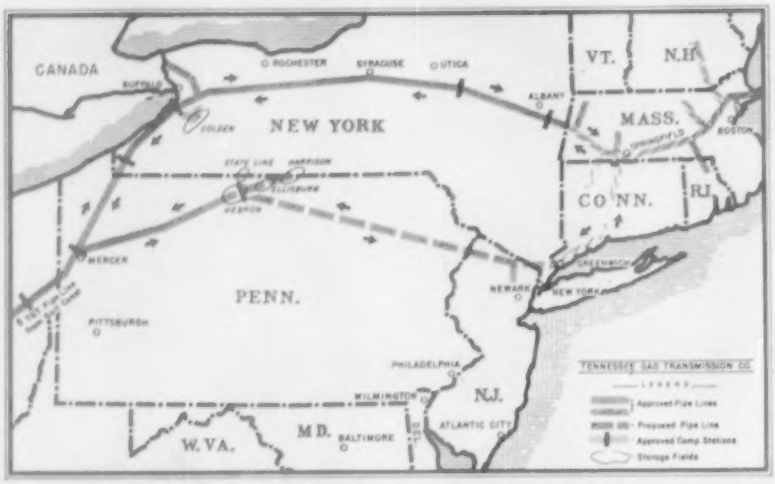
One will continue north on the upper or outer leg of the loop where it could be diverted to storage in Colden field near Buffalo, or sent onward past Rochester, Syracuse, Utica, and Albany to Springfield, Mass., ordinarily for service to New England. The gas would pass through compressor stations now in service near Buffalo, near Utica, and near Albany.

The other stream will leave Mercer and follow the lower or inner leg of the loop through Station 313, Coudersport, where it could either be diverted to storage in one of the other storage fields or dispatched on to the metropolitan New York area.

Should the market requirements change, additional gas from Hebron storage field (and Harrison, State Line, and Ellisburg when developed) could be dispatched east to the New York City area, and gas from the same storage area could be sent southwest back to Mercer where Station 219 engines would pump it north through the outer leg of the loop.

The Coudersport station would be able to pump gas either (1) into underground storage, (2) east to the New York City area, or (3) southwest back to the Mercer station.

In addition, if something were to happen on the line between Coudersport and New York City, gas could be dispatched south from Springfield through the Connecticut pipeline, thereby maintaining service to the New York area. At the same time, storage gas from Hebron could be redelivered to the Mercer station to augment the supply feeding the north leg of the loop, which would be carrying the whole burden.



PROPOSED 1,000-MILE LOOP of natural-gas pipeline. As the arrows indicate, gas could be distributed to any point on the loop from either direction.

Conversely, if something were to happen to a portion of the line on the north leg of the loop, gas could be diverted north through the Connecticut line to the Springfield market area while at the same time gas continued north from the Mercer station as far as the point of interruption until repaired.

Operatingwise and dispatchingwise, this is surrounding the market area with a loop of pipe with a tremendous source of builtin supply, and being able to supply the market area of the several customer companies from either direction.

Storage program . . . It may be interesting to look at the magnitude of the company's proposed storage program, in terms of equivalent aboveground storage facilities. Assuming use of the conventional wet seal gas holders, each having 2 million cubic feet capacity, 38,500 holders would be required; and if it were possible to place them all side by side, it would require 15,400 acres of ground, or more than the land area of Manhattan Island. Thus the holders would more than cover the island, from the Battery to the Bronx and from the Hudson to the East River.

The Tennessee Gas underground storage system will adequately provide the New York area with a service heretofore unheard of in the magnitude proposed. It allows the customer companies to deliver their excess summer gas to Tennessee Gas for storage in the company's underground banks, for redelivery to them at their options during periods of high demand.

This arrangement is somewhat similar to performing a financial banking service for the customer, except that natural gas is banked rather than money. The company becomes the depository, with the customer depositing cubic feet of gas to his account during low-demand periods and making withdrawals of cubic feet against his balance during high-demand periods. It is assumed that the top storage gas will be delivered to the customers over a 120-day period annually.

To fully utilize the 1,000-mile loop with the integrated underground storage and the contemplated storage service, much research and study will be required to develop new methods and new equipment for the future.

During the next 10 years, valuable advances in long-range weather forecasting may well occur. Even now, techniques are being improved year by year, with scientists at some of the better-known universities working with personnel of the Air Force and other services to further this work.

Potential growth . . . Since the potential growth of the natural-gas industry in the northeastern part of the nation is to a great degree along house-heating lines, with extremely heavy seasonal fluctuations in demand due to weather conditions, Tennessee Gas may well become more preoccupied with weather forecasts in the next 10 years than in the past 10, especially in operation of the 1,000-mile pipeline loop. Advances in techniques of weather predicting thus will be watched by the company with much interest.

The next decade, on this pipeline loop and possibly elsewhere on the Tennessee Gas system, may see installation of automatic or "floating" com-

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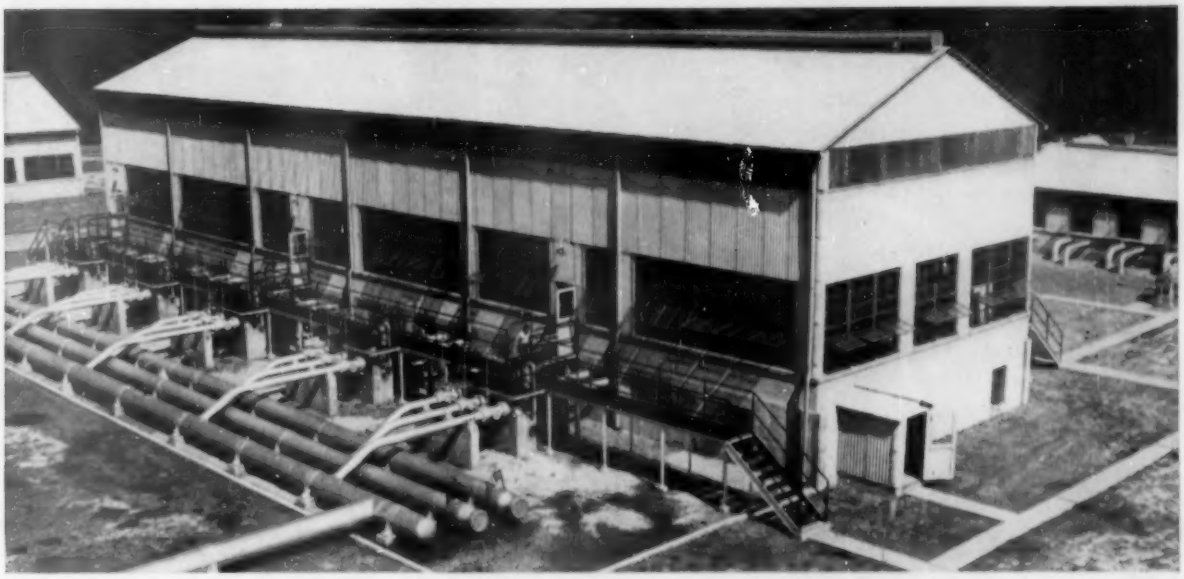


COMPRESSOR BUILDING at Compressor Station 114, Catlettsburg, Ky.

● Large Diameter, Improved Cylinders ● Exhaust-Driven Supercharging
● Intermediate, Automatic Stations ● Better Piping . . . These will spark next decade's

Improved Station Design and Operation

by E. S. Murray and R. V. Mertz

INTERESTING possibilities for future improvements in compressor-station design and operation by Tennessee Gas Transmission Co. include:

- Continuation of the present program of replacing conventional-type cylinders in compressor engines with large-diameter, improved cylinders.
- Application of recent developments in exhaust-driven supercharging as fully as economics and efficiencies will justify in comparison with costs.
- Installing intermediate compressor stations to raise mean line pressure, the stations perhaps to be operated automatically.
- Further research on station piping and applying the results to reduce present piping losses of pressure and power.

While these appear to be the most promising at present, it is quite possible and certainly highly desirable that the inventiveness and know-how in the industry and the equipment-manufacturing industry may produce equally important results along different routes.

Tennessee Gas' original pipeline was powered 10 years ago by 60,000 hp. in seven stations. Average daily delivery for the first year was 201,546 M.c.f. The stations were staffed with 209 employes.

Since then a continuous expansion and improvement program has gone forward. The 26 stations now in service have 483,380 installed horsepower, and are manned by 1,260 employes. In the first 2 months this year, system deliveries were approximately 1,463,000 M.c.f. daily.

Compressor-Cylinder Development

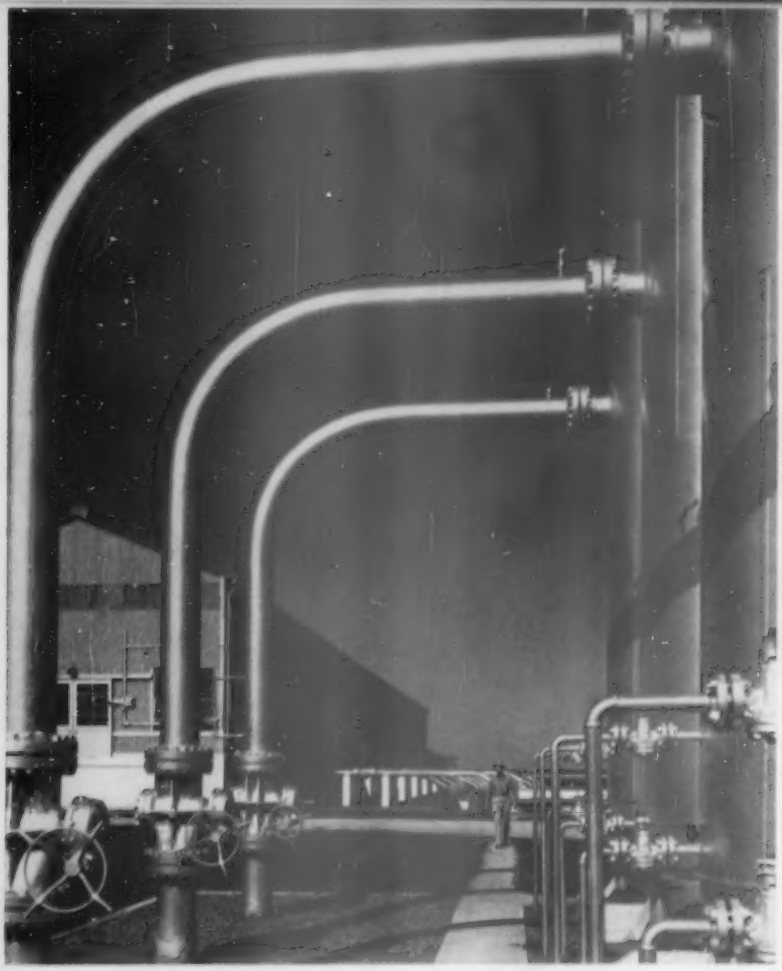
Perhaps the greatest single improvement made during the company's first 10 years at its stations was in compressor-cylinder design. Very early, conventional concepts of an efficient pipeline compressor proved inadequate.

This was brought out clearly when the so-called intermediate stations were added. It was demonstrated then that the most efficient compression ratio (comparing discharge pressures and suction pressures) was 1.5 or lower. Up to 40 per cent of the developed horsepower was found wasted in overcoming pressure losses through compressor valves and gas passages in the cylinders.

A large-diameter cylinder with large fixed and variable clearances was shown to be much more suited to system needs, permitting the installation of compressor valves of sufficient area to reduce valve losses to an acceptable figure. The large clearances made operation possible over wide ranges of suction and discharge pressures at maximum efficiency and full horsepower loading.

A nearly completed cylinder-replacement program started in 1952 was well timed in that new devices and methods being developed for increasing horsepower output of existing engines will permit use of full capacity of the new cylinders.

Engine improvements . . . Of parallel importance with changed compressor-cylinder design has been improvement in engine power. Natural gas is the ideal high-compression fuel for the prime mover, and it was obvious that engine compression ratios much higher than those generally used would give



COMPRESSOR STATION No. 1, at Agua Dulce, Tex.

more power on less fuel.

Most of the gas supply of Tennessee Gas comes from high-pressure gas wells or has passed through gasoline or cycling plants. Thus the low-octane rating heavier ends have been stripped from the gas, leaving essentially pure methane.

Using methane, the mean effective pressure or compression ratio of the engines can be increased to around 18 to 1. Being in the diesel range, this high engine compression ratio gives fuel economy comparable with best power-plant practice. Simply by installing new power heads, compression ratio has been increased on a number of the existing units to take advantage of the ideal fuel.

Engine manufacturers have progressively increased compression ratios until their newer equipment does the same work as the first engines installed but with about 20 per cent less fuel. And an increase in output rating has been accomplished at the same time. Essentially the same equipment has been rated upward about 15 per cent by use of higher compression ratios.

Scavenging air cooling . . . With increase of engine compression ratio, detonation or knock becomes a serious problem. Cause is premature ignition of the fuel-air mixture due to the high temperature of compression. It can be eliminated in several ways. One is to cool the scavenging and combustion air, and good results have been obtained here at little equipment cost.

Water-cooled finned-tube heat exchangers were built to fit into present scavenging air piping, and a small water pump was installed to circulate water through finned tubes to cool the air after compression. Because of the increased density of the cooler air, more pounds of it became available for combustion, allowing the use of more fuel and higher horsepower output. An increase of up to 20 per cent in power can be gained by adequate cooling of scavenging air, depending on outside air temperatures.

These improvements are being applied to equipment installed prior to development of the improvements. In some cases the improved design is needed to increase the horsepower and capacity, while in others the changeover may be justified on fuel savings alone. Increases in the field cost of gas, in some cases triple that of field gas when the pipeline system began operations, makes fuel consumption a more important consideration than before.

Exhaust turbocharging . . . Tennessee Gas has become the leading exponent of exhaust turbocharging for two-cycle engines. With conventional engine design, a large amount of crankshaft horsepower is used to pump scavenging air and combustion air. And large amounts of energy are available in exhaust gases. Combustion gas-turbine and turbocharger design applied to aircraft has pointed the way for the same principle to be applied to large gas engines.

Use of exhaust-drive superchargers on large four-cycle diesel engines has been common practice. But it had long been thought that the equipment could not be applied to the two-cycle engine because of difficulty of making cold starts without auxiliary air supply.

Recently, it has been shown that this can be done, the installation being in one of Tennessee Gas' compressor stations. Standard starting procedure is followed and the engine requires only a few more seconds starting air flow before the exhaust-drive blower furnishes enough combustion air to run at full load. The supposed difficulty proved wholly imaginary.

Application of exhaust-drive blowers is to be followed vigorously, for possibilities of gaining capacity are great, ranging upward to as much as 20 per cent. This means peak-day deliveries may be increased as much as 250,000 M.c.f. with the same basic equipment and same operating force.

Station Spacing

Obviously, more gas can be pumped through existing lines by raising the mean line pressure. This can be done by installing intermediate stations properly designed for low compression ratios and by adapting all compressors in existing stations for the resulting low ratios.

Two of the various methods worthy of consideration when installing intermediate stations are:

1. Reciprocating stations of latest design, using compressor units similar to neighboring stations for operating economy, may be installed.

2. Power units may be attached to well-designed centrifugal compressors suitable for low ratios. Such a power unit may be an electric motor using either company-generated electricity or current bought from a convenient supplier of industrial power; or it may be

NEW "C" STATION of Tennessee Gas Transmission, at Midland, Tenn.

T.G.T. . . . 10 Years Later

a gas-fired turbine specifically sized for the job at hand.

Some consideration may be given use of standard steam-driven turbines to drive the centrifugal compressors where fuel, water, and load factors are favorable. Economical use of centrifugal units of large capacity will be limited by inadequacy of available line pipe and fittings rather than the overall mechanical performance of the large centrifugal unit. Many gas-fired turbine-driven centrifugal units and motor-driven units are now in service. Having proven their mechanical worth, they are worthy of consideration for new installations.

Automatic operation . . . Automatic controls can be built into these units, permitting operation from a remote or central station. Past and current experience in the field of remote controls has proved that dependable, predictable results can be obtained through the control system.

Other factors such as labor laws, insurance, power failures, trespassers, and fire and explosion hazards must be included in consideration of automatically operated stations. Each installation has its own specific characteristics and limitations, making generalizations difficult. In some cases, guaranteed safety and dependability of service are worth a considerable outlay in operating labor.

In the future, the accepted concept of underground storage near the final market area probably will minimize the need for semiidle intermediate stations, or conversely, will permit full load operation of all facilities throughout the year with attendant savings in investment and operational costs.

Station piping . . . The original single pipeline did not present much difficulty in regard to pressure drop through station piping. Single suction and discharge headers were required to compress gas through the single line.

As the system grew, however, the need for flexible station piping became apparent. Plans for future stations include provisions for up-to-date station piping, and piping at existing stations is being revised in an attempt to further reduce the pressure drop.

When it is remembered that mainline pressure drop is only about 3 psi. per mile, station piping must be well designed or more stations would be needed merely to make up the pressure and horsepower lost station piping. Even the best design still incorporates a disproportionate amount of pressure loss in the station boundaries.

Air cooling . . . Much progress is being made in equipment to meet cooling requirements in the compressor stations. All cooling of lubricating oil, jacket water, and gas was done with water in conventional cooling towers in the original seven stations. Time has proved this method very costly and wasteful where temperatures of the cooled fluids are high enough to allow cooling with air. Jacket-water cooling, for instance, requires that the heat must be removed over a small range of temperature and at a high-temperature level, ideal conditions for air cooling.

To be successful, the air-cooled unit

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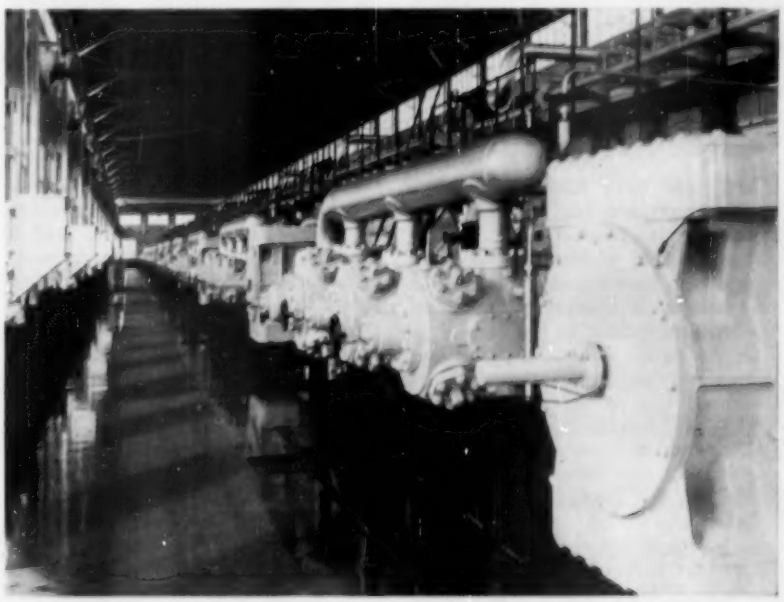

INTERIOR of compressor building at T.G.T. Station 17, near East Bernard, Tex.

Tennessee Gas Transmission Co.'s new operational research laboratory building.

Research Vital Part of T.G.T. Operation

Basic work to date has been primarily of "applied research" type

by O. H. Moore

RESEARCH in the natural-gas industry is in its infancy, and great growth for it may be expected in the next 10 years.

This is especially true of the transmission phase of the industry, where intensified work is expected to be done along lines which in the last decade have resulted in substantial economies and increases in efficiency. In addition, efforts will be made in new directions where the outlook is promising.

Tennessee Gas Transmission Co. in its early operational days nearly a decade ago carried on its research as part of its other operations. The possibilities of a more organized effort were early recognized, and the result was the operating research department of the company.

The basic work performed to date by the department has been primarily of the "applied research" type, dealing with operating problems. The company's high-pressure, multiple-pipeline gas-transmission system extends from the Mexican border to the New England seaboard, with wide variations in weather along the route and other conditions and problems of equal diversity. The solution to a problem in one location will not always work in another spot. So there is never a dull moment in this type of business.

The volume of gas transported daily by the company is of such magnitude that only a slight improvement in efficiency often returns its cost many times. Rising cost of field gas makes it imperative that we keep abreast of every possible chance of improvement. With no end in view to this upward trend, all are challenged to seek every possible way to improve operations.

Work Going On

Work has been concentrated on compressor-cylinder performance, supercompressibility and gas deviation, fuel consumption, gas pulsation, and pipe vibration. Some work has been done on pressure loss in yard piping and main-line valves, pipeline flow efficiency, engine ignition, horsepower requirements per M.M.c.f. gas compressed per day, and instrumentation for test work and routine operation. These items will receive more attention in the future.

Compressor cylinder tests . . . Since satisfactory instruments for cylinder test work were not available until 1948, a number of compressor cylinders were installed which after research were found capable of improvement. These cylinders had flat load curves with no provision for a range of ratios of compression. The initial cylinders were equipped with only two suction and two discharge valves, thereby limiting the valve-lift area.

It was known that fuel consumption was most efficient at full-load conditions. So work centered around compressor-cylinder design that favored full load under actual operating conditions, with provision in the cylinder to permit full load through a wide range of ratios of compression. As the company increased its gas sales, new points of supply and delivery were constantly being made on the system. This, coupled with loop-line and compressor installations that were required to move this additional volume of gas, resulted in variable-operating-pressure conditions. Adding clearance to unload a compressor cylinder after it reached a predetermined ratio of compression had been in use for many years, but the principle of clearance had not been put to its full use.

With these known facts at hand, T.G.T. engineers came up with a suggestion that large-diameter cylinders with large clearance (a portion as a fixed clearance and the balance in clearance pockets) be purchased instead of the small-diameter, small-clearance-type cylinder. This suggestion has proved to be a sound one in more ways than one. These cylinders permit more valves and larger gas passages to be built into the body of the cylinders. The increased valve area reduces the per cent of waste within the cylinder proper, making more horsepower available to compress gas.

The improved performance of the compressor cylinder, coupled with improved fuel-burning characteristics within the power cylinders proper, has resulted in a marked reduction in fuel consumed per M.c.f. of gas compressed.

In Fig. 1, system average figures for cubic feet of fuel consumed per M.c.f. of gas compressed is plotted against

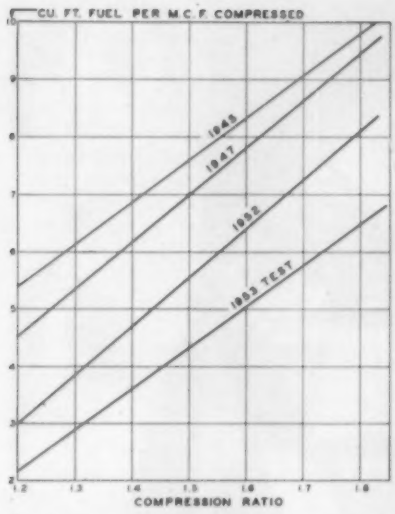

Fig. 1—System average figures for cubic feet of fuel consumed per M.c.f. of gas compressed plotted against ratio of compression for different years.

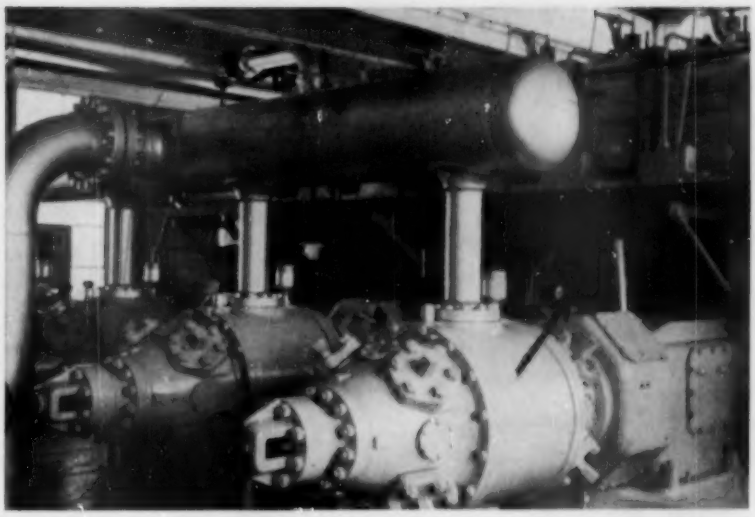

Fig. 3—Tests have been made with heat exchangers placed between scavenger cylinder and power cylinder to remove heat of compression from scavenger air. Arrow points to heat exchanger.

T.G.T. . . . 10 Years Later

ratio of compression for the years 1945, 1947, and 1952. Data for the 1953 curve were secured from a test at one compressor building fully equipped with engines of the latest design. It is not expected that the system average figure could ever be pulled down to that of this one compressor building, but the 1953 curve is a good goal at which to shoot.

This improvement in fuel consumption represents an annual saving in fuel cost of approximately $94,000 when applying the 1945 fuel-consumption figure to the 1953 field price and volume of gas compressed. Expressing this saving in another way, there is a potential annual gross earning to the company approximating $200,000 when the average sale price of the gas is applied to the actual volume of gas that would have been burned out of the line by the engines had this reduction in fuel consumption not been realized.

High-compression engines . . . The turboflow gas engine developed by one manufacturer is probably the initial starting point of what is known today as the high-compression engine. The engine created quite a stir in the gas industry, and had everyone guessing for some time as to how its basic principles of operation differed from those of the conventional low-compression engine. Prior to the announcement of the turboflow engine, it was considered that compression pressures of 120 to 130 psig. were the upper limit in the power cylinder of a natural-gas engine.

Detonation became very severe at high pressures, and there appeared to be no way to break through this barrier. Experiments proved, however, that fuel mixtures previously assumed to be improper ratios of air to gas could be made to burn in the two-cycle gas engine, thereby permitting the higher compression pressures. The mysterious principle of operation of the new engine did not remain a secret, and it was soon discovered that the principle (high compression) could be applied to existing units. Conversion of the standard engine to high compression type units is resulting in a 12 to 15 per cent saving in fuel per brake-horsepower

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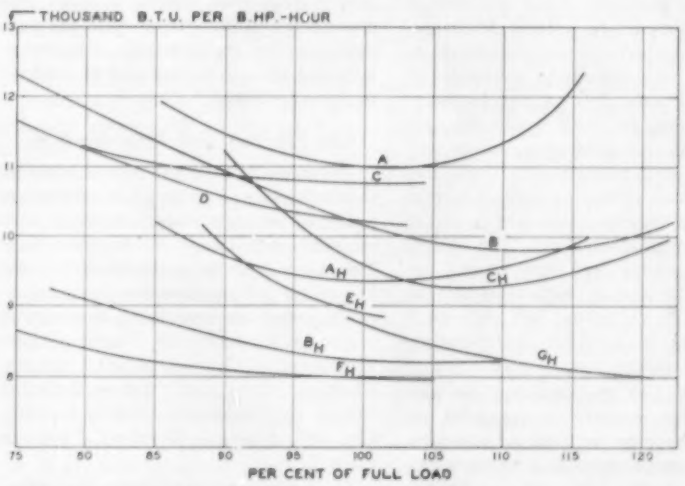


Fig. 2—Fuel consumption and B.t.u. per brake-horsepower hour vs. per cent of full load for several makes of engines on the T.G.T. system.

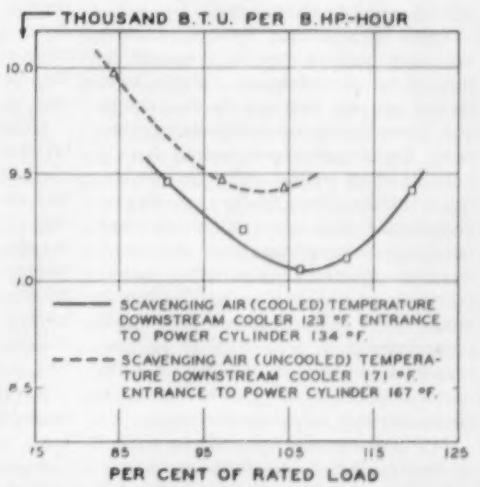

THOUSAND B.T.U. PER B.HP.-HOUR
SCAVENGING AIR (COOLED) TEMPERATURE DOWNSTREAM COOLER 123 °F. ENTRANCE TO POWER CYLINDER 134 °F.
SCAVENGING AIR (UNCOOLED) TEMPERATURE DOWNSTREAM COOLER 171 °F. ENTRANCE TO POWER CYLINDER 167 °F.
PER CENT OF RATED LOAD

Fig. 4—Comparison of fuel consumed in B.t.u. per b.hp. with cooled vs. uncooled scavenger air.

STRINGER BEADS being applied by welders to pipe being laid near Auburn, N. Y., for T.G.T. line.

LOWERING a section of 30-in. into ditch on T.G.T. looping project near Portland, Tenn.

Builtin Efficiencies Assure Continued Growth of Natural-Gas Industry

Even impact of conversion to nuclear power would not be severe

by J. J. King

THE natural-gas pipeline industry is in a strategic position to continue its growth and expansion. With its builtin efficiencies, including low labor factor, continuous 24-hour per day operations, and underground locations, it offers many advantages in the fields of fuel and transportation.

Great strides have been made and are being made in improving operations throughout the industry. These have shown up, for instance, in the design and construction of compressor cylinders. Significant improvements have been realized in the efficiency of the gas engine. Present-day gas-engine compressor units are available in large horsepower increments and are much more compact than equipment manufactured several years ago. In recent years the high-pressure centrifugal compressor has been applied to gas-transmission service using electric motors, combustion gas turbines, or steam turbines as prime movers.

It is possibly still too early to predict as to the degree of utilization of centrifugal compressors in the future for high-pressure gas transmission, nor is there positive indication that any single one of the three types of prime movers currently being used is superior in any given case. Where electric power is available at favorable rates, this type of drive is attractive, since attendance cost is low and water supply does not present a problem. The gas-turbine drive is particularly suitable for large-capacity pipeline systems, inasmuch as the units are currently available in sizes of around 5,000 hp. and larger.

Experience to date with the gas turbine has indicated very satisfactory operating and maintenance costs and fuel economy compares favorably with that of gas engines commonly in use in the gas-transmission field. The steam-turbine drive has had very limited application so far in high-pressure gas transmission; therefore, not too much information is available on operating and maintenance costs.

Regardless of the direction the gas-transmission industry moves with respect to the type or types of compression equipment utilized, it appears certain that as the price of gas in the field increases, more attention will be paid to fuel economy of the prime movers using gas. There are, of course, additional factors which must be considered in evaluating the characteristics of the various types of prime movers available for gas transmission. It appears reasonable to predict that the next 5 years will witness marked improvements in the efficiency of the gas-engine-driven reciprocating compressor unit and the gas-turbine-driven centrifugal compressor.

Gas Pipelines and Petrochemicals

In recent years the petrochemical industry has looked to gas-transmission pipelines as a possible source of raw materials for many of its processes. Two large operations involving the use of natural-gas pipelines for petrochemical purposes are now being carried out —one in Kentucky by Tennessee Gas Transmission Co. and Mathieson Chemical Corp., and the other in Illinois by Panhandle Eastern Pipeline Co. and National Distillers Products Corp.

In these operations light hydrocarbons, such as ethane and propane, are

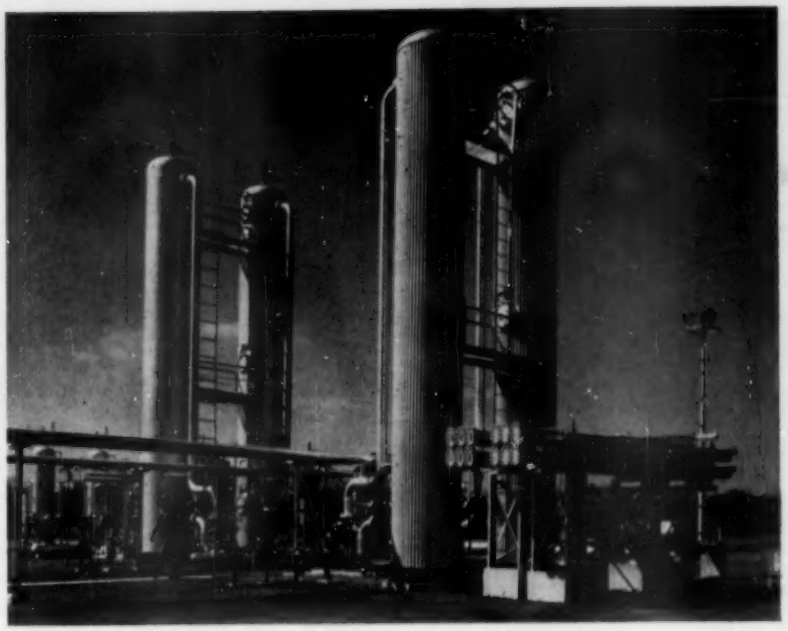
extracted from pipeline gas several hundred miles from the natural-gas source and these materials converted to a variety of chemical end products, including ethylene glycol, ethylene dichloride, synthetic alcohol, and many other chemicals required by our national economy. The extraction of the light hydrocarbons does not impair the quality of the natural gas for ultimate consumption but does allow upgrading of the removed hydrocarbons when converted to useful chemical end products. Otherwise, these valuable hydrocarbons in the natural-gas stream are consumed along with the methane.

Exhaustive studies have been carried out during the past few years to determine the most advantageous location for petrochemical plants where it is anticipated that the basic raw material will be light hydrocarbons obtained from natural gas. If a petrochemical plant is located in an area where natural gas is produced and where fuel gas and the process hydrocarbon raw materials are available at the lowest possible price level, there frequently is presented the problem of transportation cost to distribution areas of the semifinished or finished chemical end products.

On the other hand, a petrochemical plant located near ultimate distribution points for the finished chemical products is generally a considerable distance from the source of natural gas. The light-hydrocarbon raw materials necessarily cost appreciably more under such circumstances.

From time to time consideration has been given to enriching natural-gas streams by adding pure ethane or mixtures of ethane and propane in order that greater quantities of these hydrocarbons might be transported in a vapor phase along with the natural-gas mixture and extracted for petrochemical purposes at points distant from gas producing areas. Several practical problems are presented in connection with carrying out this type of operation, such as the falling out as a liquid in the pipeline of the propane due to low ground-temperature conditions, the difficulty of extracting all of the ethane and/or propane added to the natural-gas stream for enrichment, and other problems.

Except in very special cases, it is doubtful that the practice of natural-gas enrichment with ethane and propane will ever be applied on a large scale. It appears to be definitely established that where semifinished and finished petrochemical end products



DEHYDRATION PLANT near San Salvador, Tex.

can be transported easily by barge and tanker, it is advantageous for the petrochemical plant to be located on deep water in or near a gas-producing area where fuel gas and process hydrocarbons may be obtained at the most favorable price level possible.

The actual construction of many large petrochemical plants during the past few years along the Louisiana-Texas Gulf Coast in natural-gas-producing areas is evidence of the soundness of this opinion.

Nitrogen Fertilizer Via Pipeline

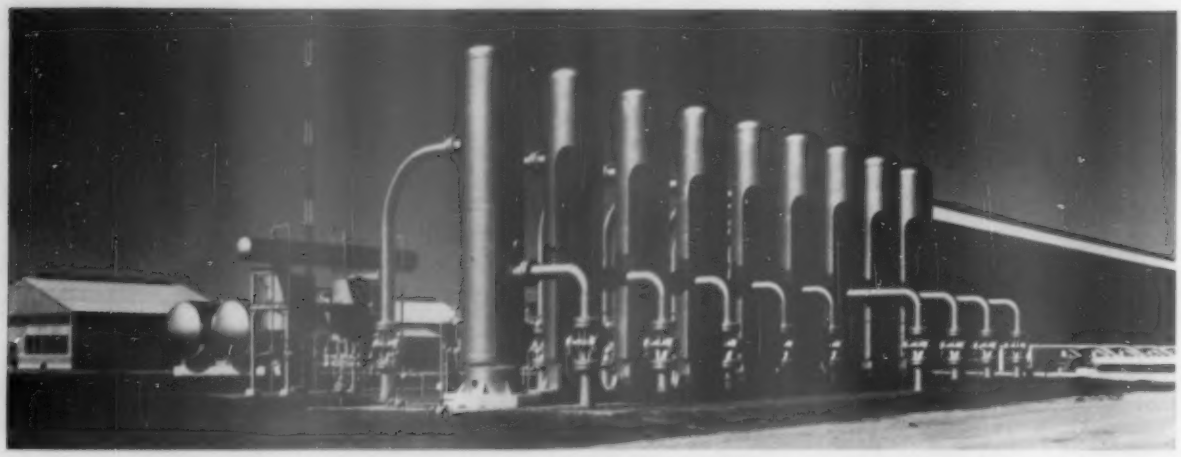
The production of ammonia from natural gas has been on the increase during the past few years and will, no doubt, continue to follow this trend in the future. Natural gas is an ideal source of raw material for ammonia synthesis gas and can compete with coke even where the natural gas must be transported many hundreds of miles. The use of natural gas for ammonia synthesis is another example of upgrading of a natural resource to a superior application.

Ammonia production for nitrogen fertilizer does, to a great extent, present a situation which dictates generally that ammonia and fertilizer plants be located as near as possible to areas where fertilizer products are ultimately consumed. The Tennessee Gas pipeline system passes through hundreds of miles of intensively farmed areas and considerable quantities of natural gas handled by the company are consumed for the production of ammonia, which material later finds its way into the soil to provide improved crop yields and more food for our economy.

Coal by pipeline . . . Since World War II, considerable research has been carried out in this country both by private capital and the U. S. Government through the Bureau of Mines on pressure gasification of coal, utilizing a basic process obtained from Germany and known as the Lurgi method. The operation as carried out in Germany was essentially a batch process and did not lend itself to operating practices required in this country. Basically, the pressure-gasification process involves the decomposition of pulverized coal under pressure and in the presence of oxygen and superheated steam, the gas generator being a refractory-lined or water-tube-lined vessel capable of operating at pressures in excess of 300 psi.

Gas produced by this process contains very small quantities of tars and has a heating value of 400 to 450 B.t.u. per cubic ftt. This coal gas, if processed to remove substantially all the sulfur, may then be subjected to a methanation process by passing the gas over nickel catalyst with the result that the heating value is raised to 900 to 930 B.t.u. per cubic foot. Sufficient pilot-plant work has now been conducted in this country to prove that the process is technically sound.

Economic studies have been made on commercial-size pressure-gasification plants, and there is definite indication that the cost of producing 900 to 930 B.t.u. gas from coal at a loca-



VERTICAL TYPE SCRUBBERS at T.G.T. Compressor Station No. 1 near Agua Dulce, Tex.

T.G.T . . . 10 Years Later

tion relatively close to gas-consuming areas may soon become competitive with natural gas, if the price at the well head continues its present upward trend. This is especially true of gas-transmission pipelines passing through areas containing large coal deposits. The Tennessee Gas pipeline system traverses some of the large coal-producing areas of Kentucky and Ohio and the company has recognized the possibilities of obtaining high-heat-value gas from this coal.

Experimental work at this stage indicates that low-grade coal is suitable for the pressure-gasification process. Extensive investigations are now being carried out on the pressure gas generator to evaluate performance characteristics of the unit and to determine what modifications in construction may be desirable on full-scale generators.

Gas Pipelines and Nuclear Power

For the past few years the press has devoted much attention to the matter of utilizing atomic energy for the generation of electric power along with other applications, including marine equipment, railway locomotives, automobiles, aircraft, and many others. During 1951 the Atomic Energy Commission arranged for four separate teams of nongovernment industrial representatives to spend a year inside the atomic-energy program for the purpose of appraising the prospect for private industrial participation in joint production of electric energy and fissionable material from reactors.

It appears the appraisals included examination of both technical and economic problems involved in production from nuclear reactors of electrical energy for industrial and commercial use. The four teams made their reports in the summer of 1952, and declassified versions became available to the general public in mid-1953. It is reported that all four groups were of the opinion "that dual-purpose reactors—electric energy and fissionable material—are technically feasible, but that no reactor could be constructed in the very near future which would be economic on the basis of power generation alone."

Assuming, however, that in the not too distant future main electric generating plants utilizing nuclear power become a reality, this very significant question arises in the minds of those associated with the natural-gas-transmission business—what will be the influence on the natural-gas-transmission industry of widespread conversion from other fuels to atomic energy? For an answer to this question it is necessary to review the fuel-consumption picture of the electric power industry.

Coal, oil, and natural gas, in general, supply all the fuel requirements for steam electric-power generation in this country. When comparing coal and oil, price differential usually determines which fuel is used. In those cases where natural gas enters the field, availability as well as price differential is significant. For example, in some sections natural gas may be available for electric power generation during the summer months, but may be interrupted for domestic or other superior uses in cold weather.

In the oil and gas-producing areas of the Southwest and in perhaps a few other isolated instances, most electric-power-generating plants operate exclusively on natural gas the year round. A study of natural-gas consumption for electric-power generation in other areas, however, reveals that if gas is utilized as fuel, it is generally on an interruptible basis with either coal or oil taking over during the winter months. An analysis of relative quantities of heat energy used for electric-power generation in the United States for the year 1953 reveals that of the total heat energy utilized, coal supplied 65 per cent; oil 12 per cent; with the remaining 23 per cent being that obtained from natural gas.

A breakdown of fuel consumption for 1939, the earliest year on which information was available, shows that coal furnished 77 per cent, oil 9 per cent, and natural gas 14 per cent. Over the period of 15 years between 1939 and 1953 the change in source of heat energy for electric-power generation has been rather gradual until 1952, except during World War II when coal consumption rose substantially with both oil and gas decreasing proportionately. It is interesting to note that this same information source shows almost no increase in percentage of heat energy supplied by gas in 1953 over 1952 for electric-power generation. Coal remained substantially the same with oil showing about 1.5 per cent increase.

Let us now look specifically at the natural-gas picture by reviewing some of the data on production of natural gas in the United States and utilization of same for electric-power generation for 1952, the latest year on which complete information was obtainable. The total reported production of natural gas was 8,862,065,000 M.c.f., and of this quantity 910,117,000 M.c.f. or about 10 per cent was used for electric-power generation. Of this 910,-117,000 M.c.f., the West South Central States (Arkansas, Louisiana, Oklahoma, and Texas) accounted for 415,-923,000 M.c.f. or about 45 per cent.

This is the area where more than 75 per cent of the nation's gas is produced. This gas, in general, never gets

(Continued on page 121)

R. F. Cox, district pipeline superintendent of District 118, Hurricane, W. Va., reports to gas control headquarters in Houston over full-period telephone circuit as he follows operations at outlying measuring station on Broad Run control panel.

Electronic Communication and Corrosion Control On Threshold of Dramatic Developments

by A. L. Stegner

ELECTRONIC improvements are coming with such rapidity that natural-gas-transmission companies in the decade ahead may weil be able to pick and choose among various excellent communications systems, with adaptability to pipeline work and cost factors the chief limiting criteria.

Likewise, in corrosion control, the next 10 years are expected to bring substantial advancements not only in equipment and methods but also in cooperative pooling of plans among companies to design out current interference in advance between pipeline systems. This would effect economies and efficiencies in comparison with post-construction adjustments among systems, which often prove costly.

Radio Communications

Spectacular growth has featured use of radio communications by the oil and gas industries since the Federal Communications Commission created the Petroleum Radio Service in 1949. More than 650 users have been authorized since then to operate nearly 26,000 transmitters on a very limited number of frequencies. This growth trend is expected to continue.

In the next 10 years researchers are expected to prove up developments, now in the test phase, which will afford greater operating ranges for radio installations.

A feature of microwave radio communications system development of the future probably will involve fewer repeater installations.

Adaptation of phases of automation to natural-gas-transmission work, already under study in the industry, is expected to receive impetus as electronic developments go forward in the future. Memory-safe and fall-safe circuitry in electronic instruments of the future may point the way to more centralized plant operations.

It is possible that some phases of industrial television may prove adaptable to natural-gas pipelining.

Multiple features may be installed in radio-communications systems, making them usable by several departments of a pipeline company simultaneously. Such systems should be more reliable and less expensive to maintain, having ample voice channels for the various departments, together with automatic signaling and lockout devices to insure privacy for messages of a confidential nature.

Transmitting reports . . . Facsimile, involving electronic reproduction of printed matter over considerable distances, appears promising for natural-gas transmission companies. Field offices could transmit reports and information required by accounting departments in headquarters offices, and could receive such information from the central office. Such circuits may be used for various telemetering functions.

Development of the transitor opens up interesting possibilities for pipelining. Transitor use can reduce the bulk of mobile units, give them longer operating life on vehicular battery systems, and reduce maintenance costs.

The wrist radio of comic-strip fame may appear on pipelines in the future where only short-range communications are necessary. The use of higher frequencies should reduce interference from other stations and afford greater signal-to-noise ratios.

At present, spectrum space is at a premium because of the ever-increasing number of users. Less band-width requirement per user, better control of assigned frequencies, and traffic control permitting more users with less interference with each other, are developments to be looked for in the future.

Turning from the future to the present, Tennessee Gas Transmission Co.'s present VHF radio communications system is composed of 41 base stations, 6 temporary base stations, and 200 mobile units, located along the pipeline system in 10 states from Edinburg, Tex., to Gloucester, Mass., and Concord, N. H. Mobile units are installed in maintenance vehicles, measurement engineers' and land agents' construction cars, and in all company-owned aircraft.

The radio system is closely integrated with company use of two full-period voice-circuit leased telephone lines. The radio system was designed primarily to furnish communications to maintenance and construction personnel along the pipeline system. However, in emergencies point-to-point radio contact and message relay is available.

Corrosion Control

From the inception of the Tennessee Gas system, the basic idea of a well-coated pipeline system supplemented with cathodic protection has been a fundamental and accepted concept. It was recognized that a system as extended and complex as the one conceived would not be possible to maintain and operate without designing into it the best available protection for the tremendously strong and relatively thin pipeline steel of today.

Manufacturers desiring to produce an even better coating product have been encouraged. It is a firm belief that better coating and wrappers will be in production in the next few years. Materials better adapted to application in the field under various conditions of machinery, labor, and weather are expected.

Regardless of the high quality of a material, the end result depends upon the application in the field. It is anticipated that manufacturers of application machinery will cooperate with others concerned to produce machinery which will under most circumstances give uniform and better results.

Varying Soil Conditions

Varying soil conditions along a pipeline traversing several states, require detailed engineering of selected areas with regard to coating and wrapping materials. Economics, however, demand that a product adequate for severest conditions (with certain exceptions, of course) fulfill the requirements.

With the growing demands for high pressures and consequent higher temperatures, there is a definite need for a pipe coating that can tolerate sustained temperatures as high as 200° F. Such a development has been initiated and its prosecution will be encouraged.

One of the radio towers of Tennessee Gas as its construction nears completion.

A problem of long standing in the industry that deserves consideration and has possibility of solution is one which has cost builders of pipelines and maintenance organizations millions of dollars. It is poor economy to properly coat and wrap a pipeline aboveground only to have the coating partially destroyed by rock because of the lack of adequate facilities to either cushion the line or crush the rock. A portable rock crusher that would be capable of reducing rock to gravel size with the ability to handle half of the spoil bank is a development to be expected in the future.

Cathodic protection . . . It is a recognized fact that coatings and wrappings are in themselves not the ultimate answer to a pipeline fully protected from corrosion. In fact, it would be poor economy to attempt to produce an absolutely perfect shield. Cathodic protection as a complement to an almost perfect coating does the job at a much smaller cost than could be done by demanding a 100 per cent perfect coating.

Although cathodic protection at first glance appears to present problems with other pipeline companies whose programs are not so advanced, cooperation among such organizations and the application of similar treatment to all lines will eventually eliminate these problems. It is anticipated that within the next decade all underground structures will be properly protected without the sacrifice of any appreciable amount of current on the part of any system and without damaging effect to any system.

The industry has taken a definite step forward in the sponsorship and support of corrosion correlating committees and the various segments of the National Association of Corrosion Engineers. This free exchange of information relative to the best accepted practices and acquainting of engineers with newly developed products has proved its worth and points the way to even more future cooperation.

Tennessee Gas has assisted in the past few years in finding the answers to some long-standing problems. One was the development of devices and methods for the elimination of electrical bonding between carrier pipe and road casing, this having been a bane of the industry. A device has also been developed for the attachment of electrical test wires to an underground pipeline without the necessity of excavation. Not only has labor been reduced, but the mitigation program has been enhanced. The development of a current interrupter of sufficient capacity has, in the conduct of surveys, eliminated the necessity for additional men and the use of valuable radio equipment.

Road crossings . . . It must be recognized that much is yet to be desired in the construction of perfect road and railroad crossings. Because of their importance, efforts toward further improvement must be made. A casing improperly insulated from the carrier pipe not only robs the system of protective current by absorption by the casing, but shields the pipe itself from protection not only within the casing, but for a distance beyond both ends.

In keeping with the policy of cooperation among the various pipeline companies, it is apparent that for all practical purposes the days of large-capacity rectifiers is over except in remote areas where no other underground structures exist.

Consistent with good engineering, due regard must be accorded those structures in the area of influence. As cathodic protection becomes more widespread among the pipeline organizations, increased attention will be given to avoiding possible interference, i.e., designing out interference rather than attempting to make costly adjustments between two systems.

The trend, it appears, will be toward smaller rectifiers in semicongested areas and even smaller sources of current in congested locations. The practices have been in effect in urban areas, but have not been followed nor even necessary in rural areas until recently.

UNDERGROUND STORAGE FIELD at Hebron, Pa., into which gas is now being injected. It is the first of five such storage projects planned by T.G.T. in conjunction with other gas companies. A workover well is shown in picture, one of several in the field. All of these had to be worked over and either plugged or readied to receive gas and later produce it when needed.

UNDERGROUND STORAGE . . .

. . . the answer to many operational problems. Here's how T.G.T. is employing this modern strategy

by S. C. Oliphant

IN the next 10 years the underground-storage phase of the natural-gas industry is certain to see continued growth and expansion, which will be limited only by availability of additional suitable storage fields located near the delivery end of transmission systems.

Underground storage provides the answer for so many industry questions related to the most efficient production, transmission, and marketing of gas that management attention must almost of necessity be focused on storage possibilities for many years in the future.

Thus, estimates of a 50 per cent increase in the natural-gas industry's investment in underground storage in the next 4 years, from the present figure of 264 to 398 million dollars would appear to be in line with best information available on the subject.

Tennessee Gas Transmission Co. became concerned over the need of gas-storage facilities several years ago and actually began operations toward developing underground-storage reservoirs 2 years ago. This first venture, which was in Hebron field of Potter County, Pennsylvania, was a joint venture with United Natural Gas Co., a company already established and operating in the area.

Hebron storage . . . Hebron field was at that time an exhausted gas field having produced from the Oriskany sandstone 6,000 ft. below the surface. This field was very appropriate for gas-storage services in that all of the wells were in accessible locations for corrective work necessary to either plug off the old hole or repair the well for injection and production service. Due to the fact that there were several operators and many leases in this field, it was first necessary to procure new leases and obtain storage rights, surface right-of-ways, easements, etc. Having accomplished this, it was then necessary to clean out all of the old original producing wells in order to be absolutely sure that no gas could leak from the reservoir at a later date.

This program has been time consuming and tedious because, upon abandonment by the original operator, no thought was given to any later use of the wells, and, consequently, nitroglycerin and other explosives were used to assist in recovering the old casing, thus leaving the hole in very bad shape for later work. In many cases, all sorts of iron, pipe, tools, wire line, and other junk have been encountered in the hole, with no explanation of how or why they got there.

Upon completion of the repairs to the old wells, it has been necessary to drill additional wells in order to furnish the greater injection and production capacities needed. It has been necessary to install an elaborate network of field lines, meter stations, and regulators in order to handle this gas. Compressors also will have to be installed in order to furnish the necessary pressure for pushing the gas into the reservoir and assist in removing the gas when it is withdrawn.

Field development . . . Hebron field covers approximately 3,500 acres and, when completely developed, may have

as many as 70 wells. It is planned to inject approximately 23.8 billion cubic feet of gas into the reservoir as base storage and cushion gas, and then, on top of this, inject and store an additional 22.5 billion cubic feet which will be called top storage gas. Top storage gas is that amount which will be withdrawn at times when the needs are in excess of that of the transmission line's normal delivery capacity.

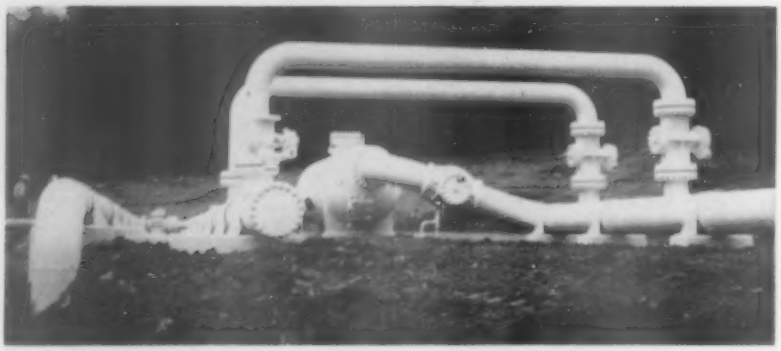
Hebron field is being developed to the extent that it alone can supply for this purpose as much as 200 million cubic feet per day. The conditions of maximum storage will be 46.3 billion feet of gas at approximately 2,000 psi. well-head pressure. The field will then be comparable to a virgin gas field except that it will have all of the development completed and available for immediate use.

The compressors will be installed in Station No. 313. It will be completed in 1954 and is planned to be 6,600 hp. in size. As the well-head pressure in the storage field increases due to the accumulated gas injection, the compressors will be used to force the gas into the wells. If high delivery rates are needed during a time that the reservoir pressure is not at its maximum, the compressors can be used to assist in withdrawing this gas from the wells and pumping it into the transmission line.

Other plans of Tennessee Gas for expanding its underground-storage facilities include Harrison, Ellisburg, and State Line fields in Pennsylvania, and Colden field in New York. These will be operated in conjunction with other gas companies now established in the area. Together with Hebron field, the four fields will have approximately 77 billion cubic feet of top storage, or 770 million per day for 100 sustained days, available to Tennessee Gas.

With the enlarged storage system, it will then be possible for Tennessee Gas to operate with enormous flexibility and capacity.

Peak demand . . . Accumulated storage of gas is an essential feature to a gas-supply company if it is to meet peak demands of its customers. It is in wintertime, when these peak demands are imposed on short notice, that the storage reservoirs are called upon for high rates of gas delivery. At the same time, the facilities downstream from the storage, all the way to the gas-supply fields on the Gulf Coast, can maintain their steady, normal near-100 per cent load-factor operations. With storage of ample capacity available, it is possible for the transmission company to serve markets requiring these peak loads and seasonal demands at a cost much less than if the lines and compressors all the way to the coast had to be designed for maximum conditions and then operated part of the year at a fraction of their capacity.



AT THIS POINT the 131-mile, 24-in. T.G.T. pipeline from Compressor Station 219, Mercer, Pa., terminates and connects with pipelines for injection of gas into the field.

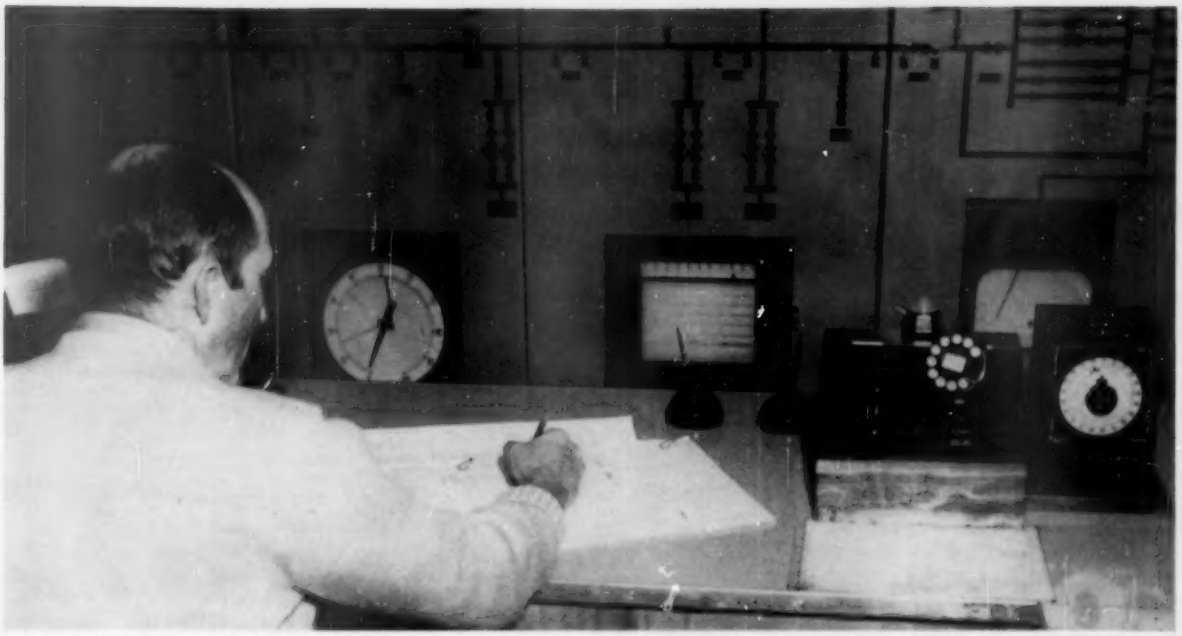
SMALL BUT IMPORTANT building at Hebron storage field. In it is housed equipment which records the volumes of gas being injected into the field.

It can be seen that storage operations permit 100 per cent load-factor operations, which, in turn, allow the transmission company to design, develop, and operate at maximum efficiency, also making possible a more uniform take from the gas suppliers in the Gulf Coast. This consistent take from the supplier in turn permits him to utilize his field personnel in a uniform manner and expect a steady income from gas sales to the pipeline, rather than the seasonal fluctuation which has occurred in the past. Storage facilities for such purposes also eliminate the installation of dual fuel systems (gas and oil or gas and coal) by consumers who would have to rely on such additional standby systems at times of peak demands.

All of these advantages exist only if storage is available in large quantities, delivery from storage is available at high rates, and the storage facilities are located near the markets. Tennessee Gas is unique in that its storage will satisfy all of these conditions.

Automatic storage . . . At present, much of the operation of injecting and withdrawing the gas is done by manual labor and manual control of the wells and compressors. In the future, such storage operations may be controlled automatically from control rooms and panel boards in a manner like that of modern refineries and power houses. When the demands on the gas line decreased, gas would automatically be routed to storage, and, likewise, as the demands increased upon the then available gas in the transmission line, the storage wells would be opened automatically into the line to meet necessary requirements.

Great progress is being made in the use of such automatic controls and regulation, so that soon we probably shall see such operations as a matter of course and as common as turning on the hydrant in your house and receiving an ample supply of water without recognizing that behind this operation is an intricate system of water wells, storage tanks, booster pumps, and other facilities.



MEASURING STATION of T.G.T. at Broad Run, W. Va. A measurement employe calls in a reading to the gas control department at Houston. Telemetering equipment is seen at right.

Two New Instruments Promise to Improve Accuracy and Economy of Gas Measurement

...One is designed to measure flow rate in pounds per minute

by E. S. Plank

EFFICIENT operation of natural-gas-transmission systems in the future will necessitate accurate measurement of the volume of gas bought, used, and sold. We can anticipate more accurate, cheaper gas measurement by the use of two new discoveries in gas-measuring devices which are being developed.

One manufacturer is doing experimental work on a "density meter" for measuring gas flow. Another new development, a "mass flow" meter which was the brain child of a professor at M.I.T., is now in the process of testing. It is designed to measure gas flow rate in pounds per minute.

These two instruments, if they prove successful and are adaptable to gas measurement, will eliminate the necessity for correcting for variables in temperature, pressure, specific gravity, and deviation from Boyle's law. This would effect a great saving in operating cost and make for more accurate measurement, all other things being equal.

Natural gas is competitive with other fuels in some places and for some uses. The choice between fuels is sometimes such a close one that only with accurate measurement can gas be chosen. A major item of expense in our business is cost of the gas we purchase, transport, and deliver to our customers. Accurate measurement is important, too, in obtaining the confidence of and maintaining good relations with gas suppliers and customers.

Work on improving the technique and equipment for measurement of gas has speeded up as the demand for it has grown and its value has increased. Ever since natural gas was established as the most ideal fuel, the gas-measurement profession has been striving to attain greater measurement accuracy.

T.G.T. gas measurement . . . When Tennessee Gas Transmission Co. began operations in October 1944, its gas purchase and sales agreements required that measurements be made as recommended in Gas Measurement Committee Report No. 2.

During the past 10 years, the volume of gas handled by the company's pipeline system increased from 207,000 M.c.f. per day to the present rate of approximately 1,500,000 M.c.f. per day. Consequently, the number of individual points of gas measurement also increased with the individual meter tubes measuring volumes as high as 80,000 M.c.f. per day on purchase and sales measurements, and as high as 135,000 M.c.f. per day on check measurements.

Although the accuracies of gas measurements made as specified by A.G.A. Report No. 2 are predicted by the A.G.A. Measurement Committee to be within ± 0.5 per cent, the large volume measurements per meter tube Tennessee Gas was experiencing demanded closer tolerances.

To attain this greater accuracy, the company embarked on a program to refine and improve the physical equipment for orifice-meter measurement.

Extra attention was given to the selection of pipe to be used for meter tubes. In some cases the section of the meter tube was bored directly adjacent to the upstream side of the orifice. Stainless steel was used and precise boring techniques followed on orifice plates.

More frequent inspection was made of meter tubes, orifice plates, and straightening vanes, to eliminate accumulation of foreign matter. Work was done with meter manufacturers to increase the accuracy of the recording instruments. Calculation techniques in the office were improved, including more frequent and closer calibration of integrators and closer checking of the application of various correction factors.

METERING STATION of T.G.T. at Hungerford, Tex.

Measurement tests . . . During the past 10 years Tennessee Gas has carried out several experimental tests in search of possible refinements.

Extensive tests were made on the bellows-type orifice-meter gage during the past 3 years. The proper-type range springs were used and these tests have shown very good results.

The design of the three different makes of this type meter is such that condensation from the gas stream does not affect its accuracy because the piping to the meter body can be so arranged that any condensation will drain back into the orifice-meter tube. Another good feature is the builtin temperature compensator which eliminates the greatest portion of the shift in the position of the differential-pressure-recording pen due to the normal changes in ambient temperature. Also, the means of transferring the movement of the bellows from inside the meter body to the pen arm, recording the differential pressure on the chart, is accomplished by a torque tube and a new type pressure-tight bearing, with a minimum amount of friction.

Since start of our operations we have decreased the differences in measurement between companies from which we purchase gas and those we sell gas to, wherein they check our measurements, from an average of ±0.5 per cent to an average of ±0.3 per cent. The over-all measurement balance for our entire transmission system for the year ending January 1, 1954, was a loss of 0.13 per cent on a total volume handled of 539,614,611 M.c.f.

The magnitude of the increased accuracy in this over-all measurement balance can be better realized if we show the dollar savings. The 0.13 per cent shown above represents an increased accuracy of approximately 0.25 per cent or an approximate saving of $128,158 during 1953.

Calculation of Volumes From Meter Charts

To measure gas in accordance with the recommendations given in the A.G.A. Gas Measurement Report No. 2, the following basic formula is used:

$$Q_h = C' (h_w p_f)^{1/2}$$

in which

Q_h = quantity rate of flow at base conditions, ft.³/hour
C' = orifice flow constant
h_w = differential pressure in inches of water
p_f = absolute static pressure in psi.

The orifice-flow constant C' is defined as the rate of flow in cubic feet per hour, when the extension $(h_w p_f)^{1/2}$ equals one, and the flow constant is calculated by the following equation:

$$C' = F_b \times F_r \times Y \times F_{pb} \times F_{tb} \times F_{tf} \times F_g \times F_{pv}$$

where

F_b = basic orifice-flow factor
F_r = Reynolds' number factor
Y = expansion factor
F_{pb} = pressure-base factor
F_{tb} = temperature-base factor
F_{tf} = flowing-temperature factor
F_g = specific-gravity factor
F_{pv} = supercompressibility factor

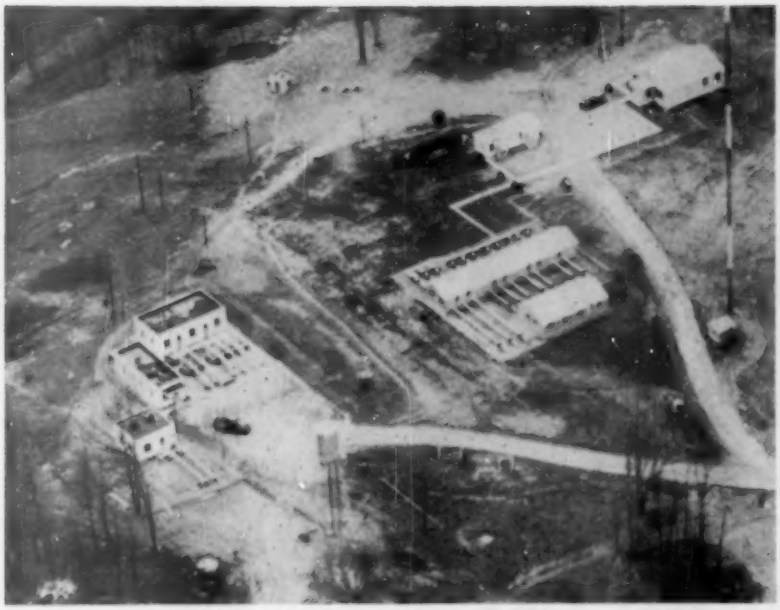
In our daily calculation work of volumes from records supplied by the orifice-meter charts, we use only three of the above variables, i.e., we correct daily for the flowing temperature, specific gravity, and apply the correction factor for supercompressibility. The remainder of the correction factors are incorporated in the orifice-flow constant for given conditions at each measuring station.

The orifice-meter-chart integrating machines are calibrated each morning to a ±0.25 per cent accuracy, and we designate one integrator for the integration of all charts from each of the three conventional makes of orifice-meter gages used on our system. We feel that we are thus able to maintain a greater degree of accuracy.

For the past 2 years the audit by one of our customers of the integration and calculation work on charts measuring gas to them, through several large orifice meter tubes, agreed with our integration and calculation within 0.0029 per cent. The total volume of gas measured in this period was 361,423,145 M.c.f., or $85,989,294.91 paid by the customer, and this difference of 0.0029 per cent, in money, was only $2,493.69. This close agreement did not just happen but was effected by diligent work and close cooperation between the two companies.

Specific gravity . . . Since the largest correction of the gas volumes measured is for specific gravity, we have required recording gravitometers to be installed at all purchase points where gas volumes of 10,000 M.c.f. per day, or over, are delivered into our pipeline and on smaller deliveries wherein the specific gravity value varies more than ±0.005. Recording gravitometers are located at strategic locations on our pipeline (past the last point of purchase) and the specific gravity values obtained are used for correcting gas volumes sold within a given range of this instrument.

This practice can be followed on our system since the majority of the gas purchased is on the southwest end of our system and the majority of the gas



AERIAL VIEW of T.G.T. metering station at Broad Run, W. Va.

sold is northeast of the State of Tennessee. We have installed or are installing, air-conditioning in the rooms where gas sales gravitometers are located to eliminate error in the operation of the instruments due to large changes in temperature and humidity. We have also air-conditioned the gravitometer rooms at our larger purchase points where practicable.

Supercompressibility . . . Since the volumes of gas we measure are very large, we have done considerable work in trying to improve the methods for predicting supercompressibility factors to correct natural-gas volumes for the deviation from Boyle's law.

Early in our operations we adopted the method set out in the C.N.G.A. Bulletin TS-354, and with some modifications set up work tables for use in our chart accounting. We set the F_{pv} values up in our work tables in 3° F. increments of temperature, 5-psig. increments of pressure, and 0.005 increments of specific gravity. In keeping the divisions of temperature, pressure and specific gravity so close, we felt that greater accuracy could be obtained. The some 900 experimental tests we have run to date on a great number of different types of gases has proved this to be true.

As the number of our gas purchase points has increased, more natural gas has been encountered with greater amounts of carbon dioxide and nitrogen, as well as measurement conditions with temperatures below 50° F. and above 100° F. Since available methods for building deviation work tables would not give us correction factors that would check our test data of samples of gas in these categories, within the 0.2 per cent tolerance we require, the company's operating research department did some excellent work in building our own tables based on a great number of actual tests for gases containing large amount of diluents.

This is done by a series of tests covering the range of operating pressures and temperatures of the station in question. If possible, tests are run at several representative specific gravities. If it is difficult to obtain samples with varying specific gravities, a substitute method of extending gravity data is used.

Deviation factors . . . From the series of tests run the following calculations are made: Isotherms plotting deviation factor versus pressure are drawn up. These cover the approximate maximum and minimum temperatures expected at the delivery point and intermediate temperature where possible.

From these isotherms a series of isobars, plotting temperature against deviation factor, are drawn on semilog paper. This plot yields a family of straight lines.

Deviation values from these graphs are posted on columnar pads listing temperature in 6° F. intervals and pressure in 100-psig. intervals.

Isotherms are plotted on cross-sectional paper, using this time F_{pv} versus specific gravity. From these graphs deviation values are taken in 0.005 increments of specific gravity and entered on the previously mentioned pads. All of the deviation values are converted to supercompressibility values by extracting the square roots, i.e., $F_{pv} = (1/K)^{1/2}$. These first calculations are made as deviation factors to eliminate mathematically some of the errors in interpolation.

The supercompressibility factors are replotted on large graphs (3 by 5 ft.) as pressure versus supercompressibility for temperature in 6° F. increments. These graphs are drawn in 0.005 increments of specific gravity throughout the range of specific gravities at the delivery point.

From these large curves, values of F_{pv} are read in 6° F. increments, 20-psi. pressure increments, and the 0.005 specific gravity increments. The divisions of the final tables are 3° F. temperature, 5 psig., and 0.005 specific gravity. These intermediate values are arrived at by arithmetic interpolation. The completed work tables are checked against the original tests, for accuracy of interpolation. The tables are then typed into convenient form for office usage. Tests are repeated yearly and if necessary changes in the tables are made.

As these extreme conditions increased, it became obvious that some work should be done to increase the accuracies of the available basic formula or devise a new method or formula.

Research program . . . In 1951 Tennessee Gas, together with Columbia Gas System Service Corp., sponsored a research program which was later joined by Lone Star Gas Co., United Gas Pipeline Co., Texas Eastern Transmission Co., Southern Counties Gas Co., and Southern California Gas Co., to develop a more accurate method capable of predicting supercompressibility factors over a wide range of pressure, temperature, and gravity, as well as including the effect of the presence of carbon dioxide or nitrogen.

Samuel R. Beitler and Richard H. Zimmerman, of Ohio State University, carried out the analysis phase of the research program. They correlated the experimental data from some 500 tests conducted of samples of gas from Texas and Louisiana Gulf Coast, Kansas, and the Appalachian area, the majority of which were run by Tennessee on the Texas Gulf Coast. Using pure methane as a basis, Professor Beitler came up with a working method correlating supercompressibility with specific gravity, heating value, and composition of

(Continued on page 121)

TAKEOFF of a T.G.T. patrol plane, used to inspect condition of company's right-of-way.

T.G.T. Planes Patrol Line

PERSONNEL CARRIER, operated out of headquarters in Houston. Plane is a modernized rebuilt B-26.

And Move Personnel on Job

by Tony Zuma

AVIATION may well play an increasingly important role in the next 10 years in the natural-gas industry and especially in the long-lines-transmission phase of the industry.

That opinion is based on Tennessee Gas Transmission Co.'s experience in operating a fleet of airplanes for transporting passengers and freight, and for patrolling its 2,200-mile natural-gas-pipeline system.

The speed with which aviation in the gas industry grows will depend on several factors. One is the rate of growth of the industry itself. Another is whether or not aviation innovations, some of which already are in something of a trial stage while others are on the horizon, receive widespread acceptance by gas-industry management.

Among these innovations, or new aviation developments, which have promise for gas-pipeline operations, are one in connection with cargo carrying, and a second involving more extensive use of helicopters.

Tennessee Gas aviation activities began with acquisition of one airplane. Aviation in the company has expanded along with company growth, and has been organized and equipped for two chief purposes:

1. To provide effective and frequent inspection of the condition of company right-of-way, and air patrolling the pipeline system from its origin in Texas near the Mexican border to its termini on the New England seaboard and near Concord, N. H.

2. To furnish fast and economical transportation for company personnel whose duties take them up and down the system.

The company's fleet of 10 planes are based as follows: eight in Houston, company headquarters city; one in Bowling Green, Ky., and one in Springfield, Mass.

Four of those in Houston are multi-engined planes, including two Martin B-26's converted from wartime bombers to fast personnel carriers with capacities of 16 passengers each and cruising speeds of about 300 m.p.h. The other two are Douglas DC-3's carrying up to 18 passengers and cruising at about 200 m.p.h.

An Aero Commander and a Grumman Widgeon amphibian, both light five-passenger planes, and two Model 170 Cessnas used for pipeline patrol are the others operating out of Houston.

Two other Cessnas are used for pipeline patrol, including one based at Bowling Green, and one at Springfield.

Each patrol plane has a pilot assigned to it who is responsible for its care and maintenance. Patrolling the system is done entirely by company aircraft, and is done more for preventive pipeline maintenance than for detection of leaks.

The patrol-plane pilot studies the terrain along the right-of-way and looks for changes in it in order to anticipate trouble which might result from flood waters, brush growth, changes in river courses, and erosion of banks near pipeline bridges. Occasionally a leak can be detected, either by a discoloration of foliage or a dry spot on otherwise wet terrain above a pipeline. On the rare occasions when leaks occur, station operators generally detect them by observing a fall in pressure indicators on gages at compressor stations before the patrol pilot is able to locate them.

The pilot also looks for new construction adjacent to the right-of-way, and alerts supervisors who contact those doing the constructing, both to safeguard their property and the pipeline system.

This identification of changing conditions, so that corrective measures can be taken to prevent damage to the pipelines and to the property of others, is the main objective of pipeline patrolling. Airplane patrol has been found to be more effective than line walking, both by Tennessee Gas and other pipeline companies. Along more than one-third of the system, from Natchitoches, La., to the Ohio River, the company operates four parallel pipelines located in a strip of right-of-way ranging from ¼ mile to 3 miles in width, and much of the remainder of the system con-

sists of triple or double pipelines. Each individual line is patrolled separately, for accuracy in reports. Patrol costs is approximately 25 cents per mile per month as contrasted with the prevailing cost of more than $1 per mile per month for patrol by foot.

The patrol planes are especially designed to meet company requirements. Features include large landing wheels, large fuel capacity, radios and special instrumentation, including automatic direction-finding equipment, for most efficient operation on both patrolling and surveying right-of-way for new pipelines.

Division and district superintendents and field maintenance men are encouraged to fly with patrol pilots, so that they may judge with accuracy the amount of maintenance required. Reports are keyed to specially prepared reference maps. Patrol pilots are in continual contact, by VHF radio communications and telephone relay, with supervisory offices.

Aerial surveys are made in patrol planes assigned to the company engineering department for that purpose.

Passenger Transportation

Passenger planes are not assigned to individuals or departments in the company, affording the dispatcher flexibility in scheduling. All requests for space on the passenger planes are handled by the dispatcher, who also purchases railroad and commercial airline tickets for space not available for company personnel on its planes.

Approximately 3 million passenger miles per year are flown by Tennessee Gas planes along its system. Since the pipeline route goes diagonally across the United States, and connections to points along the system by commercial plane or railroad usually are indirect, the company passenger plane service carries employes to work locations quicker, saving time and thus making for more efficient use of their time.

Cargo transportation is scheduled by the dispatcher in the same way as employe travel. The larger planes of the fleet can carry as much as 5,000 lb. for 500 miles, or one-half as much for twice as far. Normally, cargo is not carried in patrol planes, but in emergencies light engine parts are transported in them.

Company airplane equipment includes repair shops. After each trip, all passenger planes are given a turnaround inspection. Thorough periodic inspections are made on longer layovers between stops. The company maintains its own shops for this maintenance.

Future Aircraft Use

Looking ahead over the next 10 years, it appears to be a distinct possibility that the patrol of long-lines natural-gas transmission systems, helicopters will be used exclusively. Further research and development in that field will be necessary, of course, for at present the helicopter is too slow and costly. Helicopters in the next decade also probably will be developed for use in picking up heavy loads, perhaps 50 tons, and moving them to locations difficult to reach, such as points on mountains or in marshes.

In 10 years, the "work horse" for moving supervisory personnel and supplies directly along the system probably will be the convertiplane—an effective airplane and helicopter, built into one unit.

It will be able to give fast transportation, and yet be able to land by the site of a compressor station on an adjacent 3-acre space. The convertiplanes may feature a detachable "pod," or attachment for carrying cargo and supplies. The plane could land along the pipeline system and quickly detach a loaded pod. The empty could be picked up later. Empties could be set down, for loading and later transportation to the desired place. Passengers on the convertiplane would not be inconvenienced, since the plane would be on the ground only briefly while cargo was detached or attached.

For time-short key personnel, both in the natural-gas industry and others with operations at widely scattered locations, a transport of special design is likely to develop in the next decade. It perhaps will be a turboprop or jet-propelled, with speed ranges of 450 to 500 m.p.h. Such a craft would cruise at altitudes in excess of 40,000 ft. to take advantage of fine weather found at those heights.

The natural-gas industry continually is seeking equipment and methods which will enable it to perform a fuel-transportation service even more efficiently and economically than at present. Aviation is doing an important job in the industry today; tomorrow, with improvements in design and operation, it seems destined to play an even more significant role.

A Look at 1964

(Continued from page 98)

heating. And because of its seasonal nature, house heating in major markets located at a distance from producing areas requires underground storage for load balancing through use of excess summer gas to shave peak-day demands on transmission systems.

This key role played by underground storage, chiefly in the northeastern part of the nation, is why in the past 10 years underground storage pools have increased in number from 50 to 168, and their capacity has increased more than 1,000 per cent, from 135 billion cubic feet in 1943 to 1 trillion 64 billion cubic feet in 1953.

Tennessee Gas has inaugurated an underground-storage program of substantial proportions in Pennsylvania and New York. Gas now is being injected into Hebron field in northern Pennsylvania, and applications have been filed in connection with two more fields for near-term development and an additional two on a somewhat longer-range basis, to be integrated with the sales requirements of the company's customers.

When ultimately developed, they will give Tennessee Gas 77 billion cubic feet of top storage, or 770 million cubic feet per day deliverability for 100 sustained days during winter peak demand.

The largest of these fields is nearer the New York metropolitan area than any comparable storage in other fields. Acquisition of underground storage, incidentally, is strategic since large reservoirs available in the Northeast are limited.

The five fields play a key part in plans for operation of the 1,000-mile Tennessee Gas pipeline loop, mentioned earlier. They give the company much added system deliverability at low investment. For each dollar the company will invest in storage, it would require 3 dollars to obtain the same amount of peak-day gas by building capacity from the Gulf Coast.

Expansion by Looping

The greatest part of the capacity added to the nation's natural-gas transmission systems during the past decade has been accomplished by looping programs. In an orderly manner, year by year as markets have developed, most of the companies have looped part of their systems to supply customers' demands.

Tennessee Gas has been one of the industry's leaders in the consistency with which it has followed up this phase of its operations, as well as the size of the projects. As a consequence it derives the economic benefits and competitive advantages of planned growth and large deliverability, much of it at less than today's costs.

A looping program is expensive, in terms of capacity added, until it nears completion. A 25 per cent looping of a system increases only 9 per cent;

50 per cent looping, 27 per cent; 75 per cent looping, 52 per cent, and of course 100 per cent looping increases capacity 100 per cent.

Tennessee Gas' 1953 looping gave the company quadruple parallel pipelines from Natchitoches, La., through the states of Louisiana, Arkansas, Mississippi, Tennessee, and Kentucky to the Ohio River. Together with compressor-station additions and enlargements, it raised design deliverability of the system to 1.445 billion cubic feet daily. Cold weather and the ability to get a little more out of the system than we ever have promised, made it possible to reach a peak-day throughput January 12, 1954, of 1.53 billion cubic feet.

Expansion in 1954

The company has been authorized by the FPC to construct additional facilities to increase delivery capacity to 1,694,500 M.c.f. per day and to 1,894,500 M.c.f. peak days.

In 1954, subject to unforeseen contingencies, the company expects to reach a daily delivery capacity of 1,560,000 M.c.f. daily.

Plans for 1954 construction include a 574-mile, 30-in. pipeline from the company compressor station near Kinder, La., to its station near Portland, Tenn. The line will tie in the middle of the existing system with the large gas reserves of South Louisiana as well as those offshore, involving fewer pipeline miles and accordingly less investment than any other route which could have been chosen to accomplish the purpose.

There will be no intermediate stations on this pipeline immediately. We can add incremental gas, at low additional cost, thereafter through compression.

New compressor stations at Coudersport, Pa., at the site of the Hebron storage field, and at Finley Lake, N. Y., on the company's main pipeline to Buffalo, are planned for construction this year. Up to 28,000 in compressor horsepower will be added to the system this year. Looping will be confined to 63 miles of 26-in. pipeline in Ohio.

Future Expansion

Continuation in the future of the past trend of rapid growth of the industry has been forecast earlier. Tennessee Gas does not plan to be left out of this development.

Applications on file with the commission, if granted, would increase the company's peak-day deliverability to 2,019,500 M.c.f. daily. By late 1957, as the storage program moves forward, something around 2,700,000 M.c.f. of peak capacity should be in sight.

Regulation

Fair regulation is the goal sought from the commission by the interstate phase of the industry. It is believed the commission will give us that. The way that body has been handling cases is reassuring.

The key words in the Natural Gas Act, which authorizes the commission to regulate interstate gas operations, are "public convenience" and "public necessity." The word "public," it might be pointed out, should be understood to include not only customers but stockholders of the various companies, who are part of the public also.

The term "fair return", if the industry is to be allowed to expand to take people off waiting lists and put them on the end of gas lines, must be construed as not only fair to the consumer, but fair to the prospective investor, whose money must be forthcoming if facilities for more service are to be built.

The commission's problem is how best to serve the public. The long look, and some industrial statesmanship, are needed.

The Phillips Case, currently under Supreme Court review, is important because it involves the amount of gas to be available for the nation's pipelines.

Availability and price of money will determine the speed with which the industry will grow and add markets. If it is available, and it appears that it will be, expansion will continue.

Indications are that its price will be within reason, since the Government must act to hold the rates down because of its own debt and borrowing obligations.

Concluding, we must recognize that the path ahead for the natural-gas industry and companies making it up is not free from problems. They will be solved, but many of them can be solved more quickly if industry leaders can get together and achieve some coordination of effort and interchange of facilities where it would be in the public interest.

Five-State Loop Will Bring Advantages

(Continued from page 100)

pressor stations. These might either be controlled remotely or automatically.

Instead of controlling pipeline pressure as present conventional stations do, i. e., increasing pressure at each station by about a 1.5 ratio, such automatic stations would be controlled by pressure. They would go into operation when pipeline pressure dropped below a preset level, and shut down when pressure had risen to another preset level.

Some compressor stations operating on this general principle are being used now on field gathering systems; however, their horsepower is small. And many of the oil pipelines have been using automatic unattended booster stations for a number of years.

In some of the later gas-fired turbine stations, now operating on several gas-transmission systems, the engineer or operator spends very little actual time in the engine room proper. Normally he is in the control room where he spends most of his time scanning the various gages which tell him how the turbine is performing.

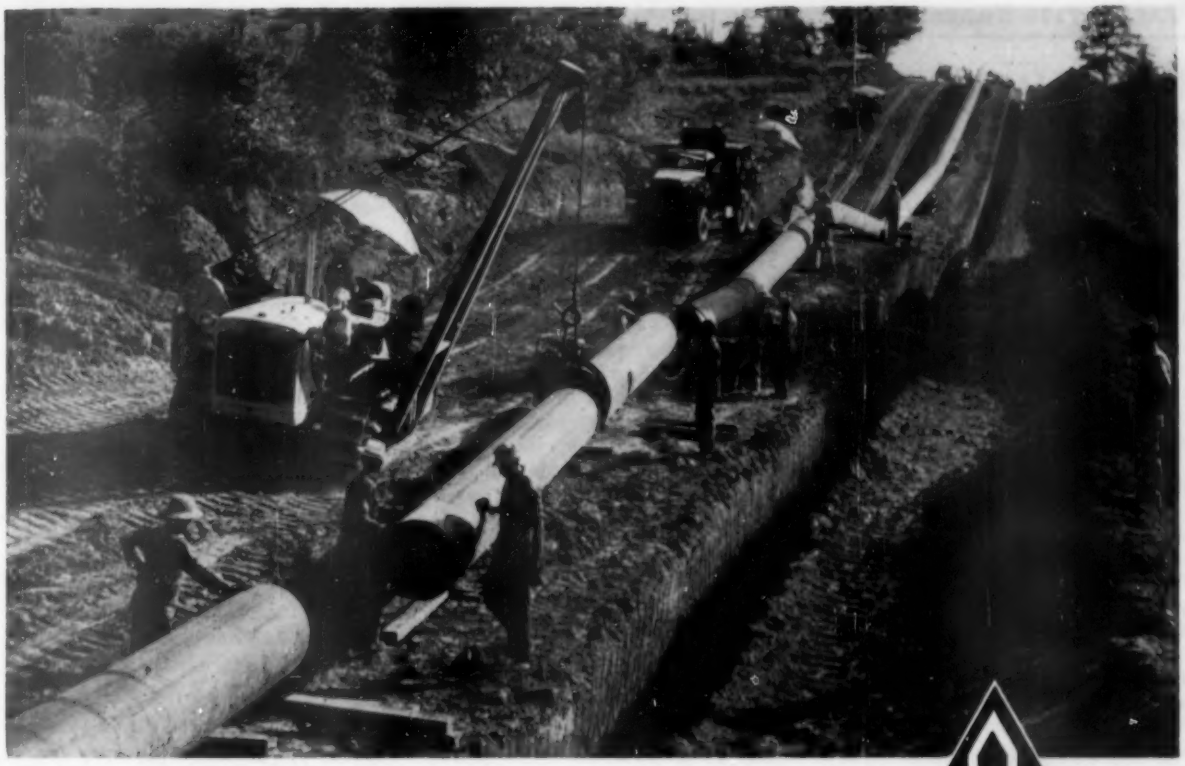
With rapid technological advances in the field of electronics, plus the development of economical media for the transmission of television signals and control channels, it is not too difficult to assume that one man at a central point could actually supervise the operation of several of these gas-fired turbine stations simultaneously as effectively as he can supervise one.

Remote stations . . . And with further refinement of controls, both pneumatic as well as electronic, the premise of a floating or remotely controlled compressor station becomes a rational concept.

The ultimate, of course, would be a central control or dispatching point where one or two men could have the key supervision of the complete operation. This office would be tied directly to the Weather Bureau, and upon receipt of an inclement-weather forecast, the dispatcher would built up his pipeline pressure through the use of remote-control compressor stations. He also undoubtedly would set up, through the use of remote control, a series of withdrawal wells in a storage field.

As the cold air mass moved in, and the heating load shot upward, the increasing delivery rate would be transmitted visually back to the central control point. This would enable the dispatcher to know instantaneously what volumes were required and at what tempo the system should operate to obtain maximum effectiveness.

After the cold wave passed and demand decreased, the central control point could match system operations to the reduced requirements.



A Salute to.. T.G.T.

● We are proud to have been working for Tennessee Gas Transmission Company since the beginning of their large expansion program.

A pioneer in cross-country big-inch gas lines, T.G.T. created a new era in comfort and convenience for home-owners—a new era of efficiency and economy for business and industry, through the transportation of natural gas to areas hundreds of miles from its source.

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Improved Station Design and Operation

(Continued from page 103)

must be built around a good heat-transfer unit. It may be either of two types, automobile-radiator-type sections or finned-tubes. If tubes are used they should be of the integrated fin type. Recent developments in finned-tube construction have made them satisfactory for all cooling needs of compressor stations. Future station designs are based on using air-cooled sections for all services.

Air cooling for high-pressure gas has been developed suitable for normal main-line operation as well as for storage-field applications. The Hebron storage field station will have this type of gas cooler designed for 2,500 psi. using a water-fogging device to saturate the cooling air on hot days. This will permit the cooled air to approach wet-bulb limitations which exist in a conventional-type cooling tower.

Automatically controlled fans on engine jacket water air coolers have been successfully used throughout the system. The automatic performance is obtained by use of variable-pitch fans under the control of a thermometer in the outlet stream.

During the past winter atmospheric temperatures of minus 3° F. were encountered on the north end of the line. During this period, the variable-pitch fans were set to hold the heat around the fin tubes thus having the effect of a solid cover. As the atmospheric temperature increased, the fans reversed their pitch and allowed cooling air to circulate as required. The entire cycle was under the control of the outlet thermometer.

Such adaptations of air-cooling units have reduced the demand for auxiliary power as well as minimized the maintenance cost of conventional spray towers. The over-all combination permits considerable savings in installation and operation with minimum personal attention. Successful operation of various types of air-cooled units have been experienced throughout the entire line from Agua Dulce, Tex., to the farthest station at Nassau, N. Y.

Ignition and fuel economy . . . During the last 2 years an automobile-engine-type distributor has been developed for use on large-size multicylinder gas engines. Company employes developed it from actual field tests. It now is being made in Houston and is available for sale to the industry. The principle is not new except for the application to large-size gas engines. The benefits are obtained through decreasing the number of moving and wearing parts and through accuracy of setting or timing which is inherent in the design.

As previously indicated, with the advent of higher compression ratios in the power cylinders, knocking and preignition also increased. Thus the importance of accurate timing can not be overemphasized. A timer that will not remain correctly timed is one of the most frequent causes of compressor-engine shutdowns.

Tests have proved that existing engines equipped with the automobile-type distributor can continuously deliver 5 to 7 per cent more available horsepower through decrease of engine down time with attendant increase in fuel economy.

In conclusion, great progress in design and installation and operation of main-line stations has been experienced in the 10-year history of this company. In keeping with the knowledge, skill, and ingenuity of the employes in the industry, it is only reasonable to predict that equal or greater progress will be made during the next 10 years.

Research Vital Part of T.G.T. Operation

(Continued from page 105)

hour, and has in every case permitted the horsepower rating to be increased at least 10 per cent.

Fig. 2 shows fuel consumption and B.t.u. per brake-horsepower hour versus per cent of full load for several makes of engines on our system. The data from which these curves are plotted were secured by engineers in the department, and represent actual field tests. Curves designated as A, B, C, and D were obtained from the standard low-compression units, and those designated as A_H, B_H, and C_H are from comparable engines converted to high compression. Curves E_H and F_H were obtained from new high-compression-pressure engines. Curve G_H is from a high-compression-pressure engine recently converted to a turbosupercharged-type unit.

These curves show the improved fuel economy of the high-compression engines in the range of 14 to 16 per cent over that of the standard low-compression unit.

The low point on the fuel-economy curve, in the opinion of the writer, represents the potential carrying capacity of an engine. When this point falls to the right of 100 per cent rated load, the optimum load should then be set at this lower point and the increased carrying capacity utilized in operation.

All high-compression engines have, in every case, developed as much as 10 per cent higher horsepower. Tennessee Gas has utilized this increase in horsepower at many points of operation by converting its low-compression engines to the high-compression type. This work will continue where advantageous, and at those points where the increased horsepower can be utilized. The potential increase in horsepower on the system amounts to approximately 22,000 hp., and at present-day construction costs this increased horsepower can be accomplished at about $200 less per horsepower than new engines. This will be a potential saving of $4,400,000 in plant investment when all these low-compression units are converted over.

Gas deviation . . . Our gas-deviation work is fundamental research into the volumetric behavior of natural-gas samples. A total of 542 tests were run in 1953, covering 158 samples of gas from 80 different companies, with 91 witnesses present to observe the tests on the gas samples from their representative companies. This work has developed into a very precise procedure, and the deviation factor has become a very valuable phase of gas measurement.

Data from these and previous samples covering the period 1945 to 1953 were used in the correlation made by Professors Beitler and Zimmerman of Ohio State University for use in calculating the F_{pv} factor in the coefficient in the forthcoming A.G.A. Report No. 3 on orifice-meter coefficients, and will form the fundamental basis for these computations for the industry. In order to exaggerate the effect of deviation from Boyles' law, it was necessary to make tests at high pressures and low temperatures on certain samples of gas, chief among which was the Jones Creek gas containing 99.8 per cent methane and having a specific gravity of about 0.558. The pressures were carried to 3,000 psi. and the temperatures to —51° F.

Because a great deal of this work was done below the freezing point of water, it was necessary to substitute liquid glycol for the thermostatic bath for temperatures down to about 0° F., and alcohol from 0° F. to the lowest temperature measurable on a mercury alloy thermometer. The lower temperatures were accomplished by evaporating dry ice in a separate mixing bath containing alcohol, and circulating the bath liquid through the chilled mixture. The —51° F. was chosen because it

was near the minimum point at which the mercury-thallium thermometer could be read. The upper limit in temperature carried on this sample was about 90° F., and isotherms were drawn for each 12° steps from —51° F. to +45° F.

Our gas contracts provide that at least yearly determinations of the deviation from Boyles' law be determined on every source of supply. Past experience indicates to us that we will receive many samples of gas in the future which will not comply with normal tables, and it is necessary, therefore, to prove compliance on each source of supply to within the 0.2 per cent tolerance that is considered acceptable. If not within this tolerance and the volume warrants, it will be necessary to construct special tables fitting this production area.

So far, only three special sets of tables have had to be composed, but it is probable that as our supply area expands, other gases will be found with tolerances greater than permissible. Each of these supply areas must, therefore, be covered by a special set of tables applicable to those specific gases. The volume of this work is probably on the order of 300 samples covering from 900 to 1,000 determinations per year—about twice the work we did in 1953.

Future work . . . The figures in improved fuel economy and increased horsepower speak well of the high-compression engines, but their operation has not always been without trouble. Detonation trouble seems to always be just around the corner, but an apparent answer has been found to this bugaboo. This seems to be "tailored" scavenger air.

These high-compression engines operate very satisfactorily at full load during winter months, but do not give good service during hot weather. Tests have been made with heat exchangers placed between the scavenger cylinder and the power cylinder to remove the heat of compression from the scavenger air. In one test installation the scavenger air was cooled to 112° F., which permitted the engine load to be increased to 1,350 hp. (122 per cent of rated load) before it began to detonate.

In another test an engine was loaded to 1,575 b.hp. (119 per cent rated load) with only slight detonation, with 137° F. scavenger air entering the power cylinders. Without cooling the scavenger air (167° F.), heavy detonation occurred with 1,370 b.hp. (104 per cent rated load).

Fig. 3 shows the heat exchangers installed on the engine.

Fig. 4 gives a comparison of fuel consumed in B.t.u. per b.hp. with cooled versus uncooled scavenger air.

These data on tailored scavenger air indicate a potential saving of 7 per cent in fuel on this unit and an increase of 7½ per cent in horsepower. Installation costs of the equipment appear to be in the range of $2.00 to $2.50 per installed horsepower. Cooling was accomplished by circulating cooling-tower water through the heat exchanger.

The cost of cooling the scavenger air is justifiable just to eliminate the detonating condition in the engines for the sake of engine maintenance, even if there were not potential savings in fuel and increased horsepower. Judgment, of course, must be exercised when making a decision to increase the load-carrying capacity of an engine in this manner. The gain (chargeable to the cost of cooling the scavenger air) is possible only during high ambient temperatures. The potential savings are already there during low-ambient-temperature periods, and these months must not be included in the economic study of the installation. Other phases such as scavenger system design, bearing loading on the engine, compressor-cylinder design, and compressor-station location must be considered in the study.

What appears to be one of the greatest advancements in the development of the two-cycle engine is the recently announced exhaust turbine-driven scavenger air system. Two engines are now on test on our system. One system has been designed for new engines only, whereas the other system is adaptable to existing units as well as new engines.

Fuel curve C_H in Fig. 2 covers preliminary test data from a unit converted to the exhaust turbine-driven scavenger system. The potential increase in horsepower that appears to be possible with this system when applied to the T.G.T. system becomes such an astronomical figure that it is hard to believe it is possible. We have every reason to believe, however, that this new development is here to stay, and we will push it with all our energy.

Efficiencies Assure Growth Of Natural-Gas Industry

(Continued from page 108)

into long-distance natural-gas transmission pipelines. It appears that a substantial part of the remaining quantity of natural gas reported as being used for electric-power generation is utilized in areas where it is available on an interruptible basis; that is, when the gas is not required for superior uses.

In the light of this analysis, it would seem that the direct impact on the gas-transmission industry of conversion on a large scale from other fuels to nuclear power for electric-power generation could not be severe. From a secondary source, it appears that electric-power generation from atomic energy could have an appreciable effect on natural-gas transmission only if electric power could be produced from atomic energy at a much lower cost than by present fuels and natural gas would be thereby displaced by electric equipment in superior applications, such as, domestic, commercial, and industrial uses. Expert opinion in this connection does not indicate such a probability in the foreseeable future.

Continued growth . . . While there seems to be an indication of a leveling off in the rate of construction of new natural-gas pipeline systems out of the Southwest, there has been no pronounced decrease in the amount of looping of existing systems originating in that area. Perhaps the reduction in the number of new pipelines is only temporary. The rate of expansion of the natural-gas-transmission industry in the future will be influenced by a number of factors, some of which have not been too significant until recently.

The economic condition of the country, the price of gas in the producing areas, the development of new markets and uses for natural gas, the cost of transportation—all will have a bearing on the position held by the gas transmission industry in the future. It does not appear, however, that the end of natural-gas-pipeline construction is anywhere in sight.

Two New Instruments Improve Gas Measurement

(Continued from page 115)

the gas evolving two formulas in terms of pseudo critical pressure and temperature.

It appears that this working method will check test data of all the gases we handle over a wider range of pressure, temperature, and specific gravity than our presently used method except the gases wherein the carbon dioxide exceeds 3 per cent. More test work will be necessary on gas mixtures with high contents of diluents. It is planned to include the Beitler-Zimmerman method for correcting for deviation from Boyle's law in the forthcoming A.G.A. Committee Report No. 3.

Telemetering . . . In the early part of 1953 the company completed and put

into operation a telemetering and remote-control system which included six remote metering stations delivering gas to one customer in West Virginia.

This installation was unusual in that for the first time the A. T. & T. Co.'s wire-line sequential operated Teletypewriter Universal Selector ("Sotus") Unit, coupled with a new automatic transmitter distributor, was used, which enabled the field dispatchers at our Broad Run measuring station near Clendenin, W. Va., to receive reading, and control rate of flow at the six remote meter and regulating stations, with the farthest station being 71 miles from Broad Run. This telemetering system allowed 51 different operations to be carried over a single wire-line circuit.

Since our operations do not demand continuous readings from these stations, selective contacts with each of the six meter stations give the dispatchers adequate knowledge of the flow rates in order to make the necessary transfer of flow rates from station to station. To maintain this kind of operation manually would require two crews of men and two cars to operate on a 24-hour basis; therefore, a considerable saving was effected by the use of telemetering and remote control, as well as keeping our contract deliveries within 0.5 per cent error.

Some improvements and refinements are being developed on the telemetering instruments, as well as on the translation of signals from the measuring and controlling instruments at the measuring stations into the carrier system (telephone or telegraph circuits and radio channels) and back into the receiving instruments at the control station.

Various manufacturers of telemetering instruments are conducting research work which will tend to increase accuracy, speed up signal transmission, and totalize group readings at the metering point before transmitting the results into the carrier.

By the use of a system employing one company's new pneumatic transmitters, readings of integrated flow from a group of meters at one location can be transmitted a short distance into another new instrument for totalizing the flow, and the results of this totalizer can then be transmitted to a central point over telephone or telegraph circuits or micro-wave radjo channels. This type of operation would be readily adaptable for telemetering flow measurements for dispatching information and would effect a great saving in time and costs for obtaining gas flow information.

The mass flow meter has been tested on the measurement of liquids only but it appears that it would be adaptable to the measurement of air, gas or steam. With the present available information, it does not appear that the mass flow meter could be used for the measurement of gas volumes in the order we are now measuring without getting into meter sizes which would be too bulky and costly to make its use economical.

Research on the density meter does indicate, however, that it can be adapted to very large volume measurements economically.

It is our plan to conduct tests on both the mass flow meter and the density meter as soon as they are available.

Should either prove satisfactory for the measurement of natural gas, and the unit cost is not too great, then one of the greatest advancements in the measurement phase of the natural gas business will have been made.

It would no longer be necessary to measure the flowing temperature, flowing pressure and the specific gravity of the gas stream, the sampling of the gas measured, laboratory work in testing these gas samples.

ARCCO
ARCCO-ANUBIS dry air
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Like many other gas transmission lines throughout the world, the Tennessee Gas Transmission Company also uses Arcco-Anubis Gravitometers for accurate recording of specific gravity on main line gas measurement.
The Arcco-Anubis Dry Air Gas Gravitometer determines and records specific gravity of gases, automatically corrected to the humidity content and temperature of the air. The difference in weight between a column of gas and an equal column of dry air is measured. This ratio represents the true specific gravity of the sample.
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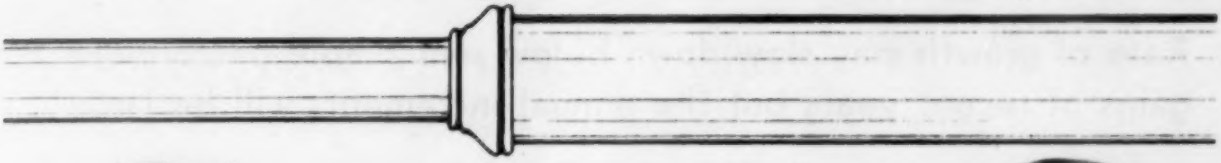
Thick, tough synthetic rubber ring anchored by plastic-covered, aircraft-cable clamps. Makes water-tight, short-proof seal at end of casing.

New TYPE "BT" CONCENTRIC-SUPPORT INSULATOR
Completely insulated steel band with only one joint to be opened wide for installation. Hard rubber skids support pipe in center of casing. Assembly clamped by plastic-covered aircraft cables.



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A short, massive Concentric-Support Insulator. Simply slide Cradle in casing end to carry weight of pipe and backfill. Replaces Insulator in end of casing.

New STYLE 2 THINSULATOR
Similar to "BT" Insulator except with steel skids throughout. Excellent for soft coatings — but does NOT center pipe in casing.

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STYLE 1 THINSULATOR
Thin Insulator with rubber-lined steel band for 10" and smaller pipe in casing only 2" larger. Welded steel skids on bottom only where joint is bolted.

** Specific features of devices illustrated on this page are covered by U. S. Patents or Patents Pending.*

† A manufacturer who renders FREE service in the field to help insure correct installations.

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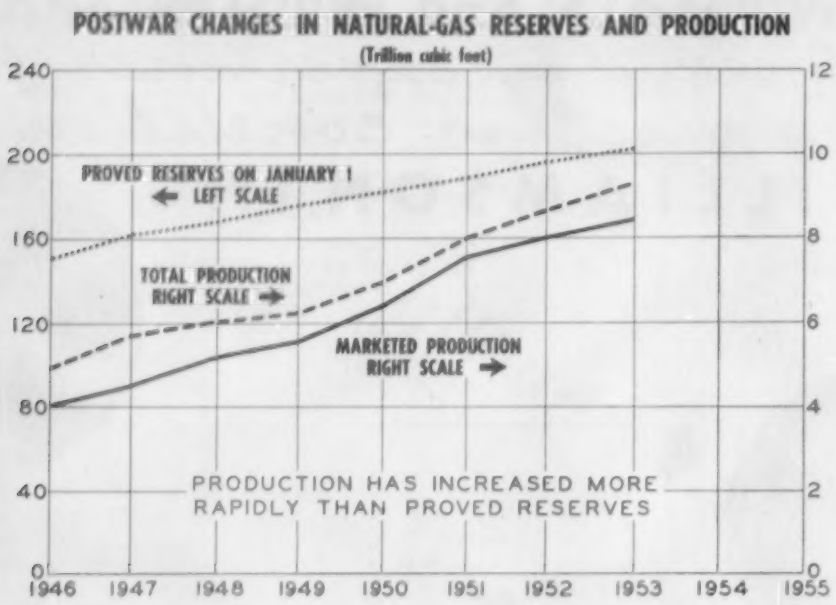

What's Ahead for Natural Gas?

Rate of growth may slow down below remarkable percentage gains of recent years but the annual increments will be large

by Richard J. Gonzalez

THE largest contribution to additional domestic output of mineral energy in the United States in the postwar period has been by natural gas. Its production has more than doubled in 7 years. Its increase in output has exceeded that of domestic crude oil, although crude oil was a much larger source of energy at the end of the war and has gained nearly 40 per cent since then. Meanwhile, coal production has decreased.

Author is director and economist for Humble Oil & Refining Co., Houston. This article was taken from an address before the American Power Conference, Chicago, March 25, 1954.

As a result of these developments, natural gas has practically doubled its share in the mineral energy output of the United States. The natural gas marketed in 1953 had a heat content equivalent to 1.5 billion barrels of crude oil or 360 million tons of coal. Thus, it supplied about two-thirds as much energy as either of these competing fuels and more than one-fourth of all domestic production of mineral energy. If the postwar trends continue, natural gas may surpass coal within 5 years and in time even challenge oil for supremacy as our leading source of energy.

More than half of the natural gas in the United States is produced in Texas. Much of the remaining supply comes from the adjacent states of Louisiana, Arkansas, Oklahoma, and New Mexico. These five southwestern states together account for about four-fifths of the proved reserves and current production of gas. Outside of this area the principal gains in output since 1945 have been in Kansas. Production in California and the Appalachian area has been relatively static for some time.

Actual withdrawals of natural gas exceed marketed production by the amount lost incident to oil production. Part of this loss is inevitable because the cost of gathering gas in small iso-

Postwar Changes in U. S. Mineral Energy Production

	Production (million units)			Energy content of mineral fuels production (trillion B.t.u.*)				Share of mineral energy prod. from natural gas, per cent
Year—	Coal (tons)	Crude oil (bbl.)	Marketed natural gas (M.c.f.)	Coal	Oil	Gas	Total	
1945	632	1,714	3,919	16,529	9,939	4,213	30,681	13.7
†1953	482	2,360	8,425	12,614	13,689	9,057	35,360	25.6
Change	—150	+646	+4,506	—3,915	+3,750	+4,844	+4,679	+11.9

*Based on unit heat values used by the Bureau of Mines. See Table 1 for additional information from 1920 through 1953. †Preliminary estimate.

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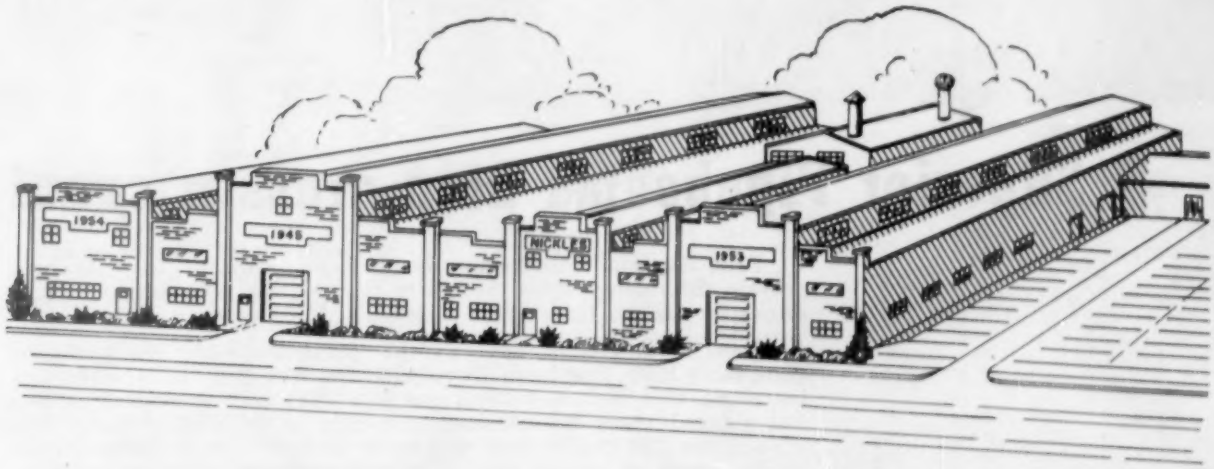

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Four Superior Pipebooms, mounted on powerful Internationals, provide the mighty slings necessary to feed this 240′ section of pipe across the McIvor Canal, near Batesville, Mississippi.

Part of a 45-mile loop on the Tennessee Gas Transportation Company's main line from Campbellsville, Kentucky to Natchitoches, Louisiana, this 26-inch, natural gas pipe (½″ wall thickness) is bent and plugged, ready for immersion. Adding to the already heavy load are a dozen 3280 pound river weights at 20-foot intervals, to counteract the buoyancy of natural gas. *(Contractor: The H. C. Price Company of Bartlesville, Oklahoma).*

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Summary of Estimated Proved Recoverable Reserves and Marketed Production of Natural Gas

	Reserves (billion cu. ft.)			Marketed prod. (billion cu. ft.)		
	Jan. 1, '46	Jan. 1, '53	Change	1945	1952	Change
Texas	78,307	105,733	+27,426	1,712	4,148	+2,436
Louisiana	19,849	31,452	+11,603	543	1,237	+ 694
Arkansas, Oklahoma, New Mexico	16,140	26,789	+10,649	509	946	+ 437
Total Southwest	114,296	163,974	+49,678	2,764	6,331	+3,567
Kansas	13,251	14,193	+ 942	146	413	+ 267
California	10,856	9,340	− 1,516	558	517	− 41
Other United States	9,386	12,209	+ 2,823	451	742	+ 291
Total United States	147,789	199,716	+51,927	3,919	8,003	+4,084

Based on data published by the American Gas Association and the Bureau of Mines. (See Tables 2 and 3.)

Natural Gas Section

lated oil fields exceeds its value. With better prices and concerted conservation efforts, the amount of gas flared has been reduced. Gas flared is now less than 10 per cent of the total output compared with about 18 per cent in 1945.

Reserves Increase

Additions to gas reserves from discoveries, extensions, and revisions of prior estimates have more than offset increasing production. Consequently, proved reserves have increased by 63 trillion cubic feet in the past 8 years. Still, they have gained only about 40 per cent whereas production has doubled. Therefore, the relation of annual gas production to proved reserves at the beginning of the year has changed from a rate of 3.3 per cent in 1946 to about 4.5 per cent in 1953. These changes mean that proved reserves of gas are now about 22 times the annual output, compared with 33 times in 1946. This relation should not be interpreted as an indication that gas reserves will be exhausted in 22 years. On the contrary, so long as proved gas reserves continue to be maintained or increased by exploration and development, we can count on adequate supplies far into the future.

The decline in the ratio of reserves to annual production does suggest, however, that the rate of increase in use of gas will be more closely related to changes in reserves henceforth than in the recent past. New gas lines are generally based on availability of reserves sufficient to assure operations for at least 20 years. They have been able to expand their movement and sales recently at a more rapid rate than reserves because there were substantial amounts of uncommitted gas at the end of 1945. Gas committed to lines

TABLE 1—PRODUCTION OF MINERAL ENERGY IN THE UNITED STATES

	Amount of production*					Energy content of mineral production, (trillion B.t.u.)		
	Coal, million net tons			Natural gas, billion cu. ft.				
	Bituminous and lignite	Pa. anthracite	Crude petroleum M.M. bbl.	Marketed prod.	Total incl. losses	Total minerals†	Marketed nat. gas	Energy production‖
1920	568.7	89.6	443	798		20,602	858	4.2
1921	415.9	90.5	472	662		16,646	712	4.3
1922	422.3	54.7	558	763		16,506	820	5.0
1923	564.6	93.3	732	1,007		22,494	1,083	4.8
1924	483.7	87.9	714	1,142		20,274	1,228	6.1
1925	520.1	61.8	764	1,189		20,903	1,278	6.1
1926	573.4	84.4	771	1,313		23,049	1,411	6.1
1927	517.8	80.1	901	1,445		22,379	1,553	6.9
1928	500.7	75.3	901	1,568		21,949	1,686	7.7
1929	535.0	73.8	1,007	1,918		23,796	2,062	8.7
1930	467.5	69.4	898	1,943		21,308	2,089	9.8
1931	382.1	59.6	851	1,686		18,275	1,813	9.9
1932	309.7	49.9	785	1,556		15,607	1,673	10.7
1933	333.6	49.5	906	1,556		16,924	1,672	9.9
1934	359.4	57.2	908	1,771		18,038	1,904	10.6
1935	372.4	52.2	997	1,917		18,921	2,060	10.9
1936	439.1	54.6	1,100	2,168		21,598	2,330	10.8
1937	445.5	51.9	1,279	2,408		22,997	2,588	11.3
1938	348.5	46.1	1,214	2,296		19,814	2,468	12.5
1939	394.9	51.5	1,265	2,477		21,653	2,663	12.3
1940	460.8	51.5	1,353	2,660		24,089	2,860	11.9
1941	514.1	56.4	1,402	2,813		26,060	3,024	11.6
1942	582.7	60.3	1,387	3,054		28,124	3,282	11.7
1943	590.2	60.6	1,506	3,415		29,407	3,671	12.5
1944	619.6	63.7	1,678	3,711		31,572	3,989	12.6
1945	577.6	54.9	1,714	3,919		30,681	4,213	13.7
1946	533.9	60.5	1,734	4,031	4,943	29,916	4,333	14.5
1947	630.6	57.2	1,857	4,445	5,630	33,672	4,926	14.6
1948	599.5	57.1	2,020	5,148	6,008	34,409	5,534	16.1
1949	437.9	42.7	1,842	5,420	6,245	29,070	5,827	20.0
1950	516.3	44.1	1,974	6,281	6,893	32,563	6,583	20.2
1951	533.7	42.7	2,248	7,457	7,967	36,119	8,017	22.2
1952	465.0	40.0	2,290	8,003	8,640	35,082	8,604	24.5
1953‡	452.3	30.1	2,360	8,425		35,360	9,057	25.6

*As reported by the Bureau of Mines except for total production of natural gas, including losses, which is from the American Gas Association. †Based on marketed production of natural gas and reported net production of other mineral fuels. The unit heat values used are those reported by the Bureau of Mines of 12,700 B.t.u. per pound for anthracite, 13,100 B.t.u. per pound for bituminous and lignite, 5,800,000 B.t.u. per barrel of petroleum, and 1,075 B.t.u. per cubic foot of natural gas. ‡Preliminary. ‖Proportion of domestic mineral energy production supplied by marketed natural gas.

has kept pace with their throughput, while the amount of uncommitted gas remaining has decreased. The available supply has become tighter as a result, despite the larger amount of proved reserves.

Increasing Use of Natural Gas

There are many facets to the changing postwar use of natural gas. Some of these are indicated by the statistics in Table 3. The following points appear to be particularly significant.

1. The use of gas has increased more rapidly outside of the five principal producing states than within their boundaries. The gain between 1945 and 1952 was 1,368 billion cubic feet or 65 per cent in Texas and adjacent producing states, compared with 2,345 billion or 130 per cent for the rest of the United States. (See Table 3.)

2. The interstate movement of natural gas advanced from 1,100 to about 4,000 billion cubic feet between 1945 and 1953. Texas and Louisiana supply about three-fourths of the gas for interstate shipment. By 1952, interstate receipts exceeded 400 billion cubic feet in Ohio and were around 300 million cubic feet or more in each of three other states, namely, Illinois, Pennsylvania, and California. (See Table 4.)

3. In the years 1946-1952, natural gas was introduced into eight additional states: Connecticut, Delaware, Massachusetts, New Hampshire, New Jersey, North Carolina, South Carolina, and Wisconsin. These states had 2,400,000 customers for this fuel in 1952 and their total consumption was 95 billion cubic feet. (See Table 4). Residential users represented about one-fifth of the households in these states as against about three-fifths in the southwestern producing states where natural gas had been used for a long time.

4. Gas was used in 41 states in 1952, the only exceptions being Maine, Vermont, and Rhode Island in New England, and Nevada, Idaho, Oregon, and Washington in the West.

5. The number of customers using natural gas more than doubled since 1945. The Bureau of Mines reports nearly 25,000,000 users, including some who receive natural mixed with manufactured gas, and utilities supplying natural gas alone report some 20,000,000 users. Of the residential customers supplied with natural gas by utilities, nearly 60 per cent used this fuel for space or central heating, in addition to the use generally made for cooking and water heating.

6. The North Central and Middle Atlantic states have the largest number of customers and the largest residential and commercial consumption of gas among the geographic areas, but the largest total use is in the Southwest because of requirements in petroleum operations and by other industries.

"Decline in ratio of reserves to annual production suggests that the rate of increase in use of gas will be more closely related to changes in reserves henceforth than in the past."

TABLE 2—UNITED STATES PROVED RECOVERABLE RESERVES OF NATURAL GAS AS ESTIMATED BY THE AMERICAN GAS ASSOCIATION

	Reserves at beginning of year (billion cubic feet)								
	1946	1947	1948	1949	1950	1951	1952	1953	1954
Texas	78,307	86,363	90,026	95,709	99,170	102,404	105,653	105,733	106,530
Louisiana	19,849	22,412	23,481	23,978	26,688	28,533	29,005	31,452	34,459
Oklahoma	10,080	10,736	11,351	11,332	11,626	11,634	11,804	11,765	12,228
New Mexico	5,190	5,905	5,990	5,606	6,241	6,991	11,590	14,039	17,522
Arkansas	870	872	890	902	874	908	931	984	1,211
Total S. W.	114,296	126,288	131,738	137,527	144,599	150,470	158,983	163,973	171,950
Southeast	3,445	3,757	3,954	3,892	3,983	3,887	3,882	3,847	4,111
California	10,856	11,126	10,164	10,193	9,992	9,760	9,482	9,340	9,159
Mountain States	2,497	2,282	2,292	4,366	4,270	4,192	4,402	4,596	6,481
Kansas	13,251	13,681	14,557	14,408	14,090	13,791	13,457	14,193	15,788
Other N. Central	920	1,029	893	1,061	1,043	1,150	1,249	1,329	1,481
Total N. Cent.	14,171	14,710	15,450	15,469	15,133	14,941	14,706	15,522	37,020
Middle and So. Atlantic	2,524	2,413	2,329	2,422	2,404	2,343	2,357	2,438	2,477
ToTtal U. S.	147,789	160,576	165,927	173,869	180,381	185,593	193,812	199,716	211,447

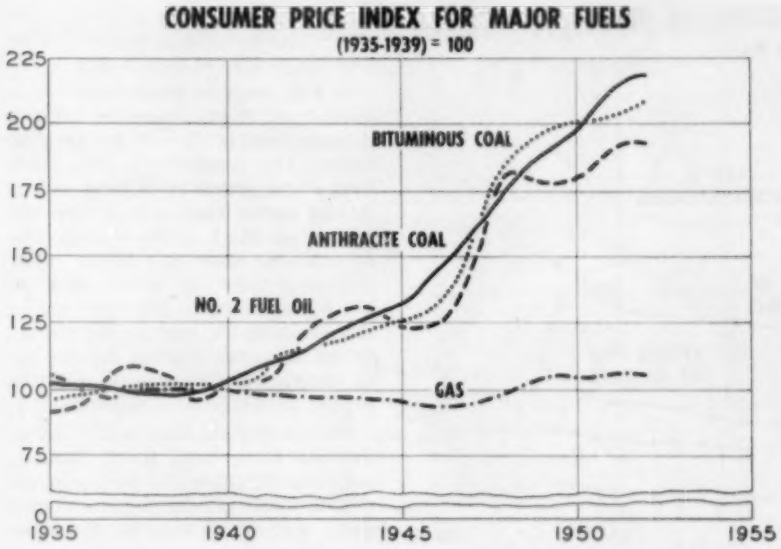
Note: There is no official series of estimates of proved recoverable reserves of natural gas prior to 1946. Available estimates for earlier years include the following totals for the United States:

Dec. 31, 1931	Billion cu. ft.	Estimated by
1931	46,000	E. P. Hindes
1935	62,000	R. E. Davis
1937	66,000	R. E. Davis
1938	70,000	L. F. Terry
1940	85,000	R. E. Davis
1941	113,800	PAW
1942	110,000	PAW
1943	110,000	PAW
1944	133,500	PAW

TABLE 3—PRODUCTION AND CONSUMPTION OF NATURAL GAS BY MAJOR AREAS
(Billion cubic feet)

	Marketed production*				Consumption*			
	1940	1945	1950	1952	1940	1945	1950	1952
Texas	1,064	1,712	3,126	4,148	874	1,348	1,825	2,175
Louisiana	343	543	832	1,237	185	326	475	599
Ark., Okla., N. Mex.	336	509	743	946	311	412	570	680
Total Southwest	1,743	2,764	4,701	6,331	1,370	2,086	2,870	3,454
Southeast	59	86	188	248	77	133	299	432
California	352	502	558	517	352	502	684	793
Mountain States	61	72	112	141	95	139	217	273
Kansas	90	146	364	413	97	160	243	280
Total N. Cent.	153	243	438	470	501	718	1,414	1,767
Middle and South Atlantic	292	252	285	296	260	322	542	881
New England								13
Total U. S.	2,660	3,919	6,282	8,003	2,655	3,900	6,026	7,613

*Difference between production and consumption for the United States represents additions to underground storage, exports, and losses. Source: Bureau of Mines.



Natural Gas Section

7. Postwar changes in the major uses of natural gas reported by the Bureau of Mines have been as follows:

Type of use—	Billion cu. ft. 1945	1952	Change
Field use (in petroleum operations	917	1,484	+ 567
Petroleum refineries	338	536	+ 198
Carbon black	432	368	+ 64
Electric-utility plants	326	910	+ 584
Other industrial	1,050	2,177	+1,127
Total industrial	3,063	5,475	+2,412
Commercial	230	516	+ 286
Residential	607	1,622	+1,015
Exports	19	27	+ 8
To underground storage (net)		363	+ 363
Grand total	3,919	8,003	+4,084

8. From 1945 to 1953 the use of gas by electric utilities has about tripled. This fuel accounts for about one-fifth of the kilowatt hours generated by utilities. In the South and the Mountain states, gas is the most important fuel for generating electric power.

The Price of Natural Gas

Many reasons account for the rapid increase in use of natural gas in recent years. Convenience, cleanliness, and high combustion efficiency make gas an extremely attractive fuel. Technological progress in the construction of large lines capable of being operated at high pressure has also been a factor in expanding the area of consumption. But the most important reason has been the attractive price of gas relative to competing fuels.

Fuel prices may be considered from the standpoint of either producer or consumer. Large differences may exist between these prices because of transportation and distribution costs. Both need to be considered because of their influence on supply and demand. In this case consumption has increased more rapidly than reserves, which constitute the basic supply. Therefore, an approach from the consumer's side will be enlightening.

Indexes published by the Bureau of Labor Statistics show that wholesale and retail prices of coal and fuel oils doubled from 1939 to 1952, while natural gas showed reltively little increase. Following removal of price controls after the war, the indexes reflect much smaller advances for natural gas than for other fuels. In many cases gas has become cheaper as well as more desirable for other reasons than coal or liquid fuel.

Average delivered prices for natural gas are listed in Tables 5 and 6. They

TABLE 4—INTERSTATE MOVEMENTS OF NATURAL GAS

States with largest interstate shipments of natural gas—amount shipped (billion cubic feet)

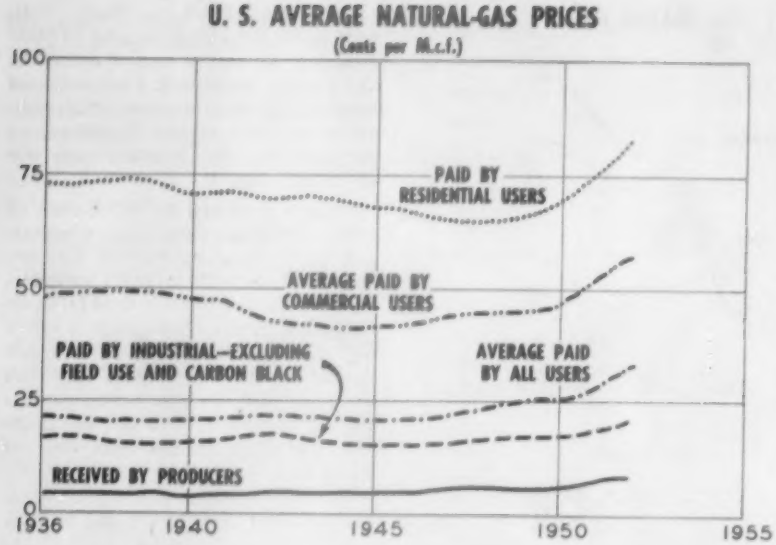
Origin—	1945	1946	1947	1948	1949	1950	1951	1952
Texas	406	451	523	718	983	1,311	1,686	1,995
Louisiana	229	204	248	294	327	396	541	694
Oklahoma	122	150	156	206	174	200	221	228
Kansas	80	94	122	186	197	228	269	287
New Mexico	36	36	43	93	80	87	156	203
Mississippi			22	37	48	79	110	136
West Virginia	113	114	116	131	123	132	124	102
Other*	120	97	97	92	76	111	136	153
Total	1,106	1,146	1,327	1,757	2,008	2,544	3,243	3,795

*Including exports.

INTERSTATE RECEIPTS OF NATURAL GAS
(Billion cubic feet)

Destination	1945	1952
New England:		
Connecticut		1
Massachusetts		13
New Hampshire		*
Total		14
Middle Atlantic:		
New Jersey		44
New York	24	190
Pennsylvania	92	302
Total	116	536
South Atlantic:		
Delaware		3
Dist. of Columbia	7	14
Florida	7	16
Georgia	36	110
Maryland	3	27
North Carolina		4
South Carolina		3
Virginia	2	20
West Virginia	42	98
Total	97	295
North Central:		
Illinois	105	343
Indiana	39	102
Iowa	28	97
Kansas	94	163
Michigan	38	187
Minnesota	36	98
Missouri	72	172
Nebraska	28	74
North Dakota	3	4
Ohio	124	411
South Dakota	7	12
Wisconsin		37
Total	574	1,700
Southwest:		
Arkansas	45	128
Louisiana	12	72
New Mexico	2	50
Oklahoma	14	23
Texas	43	66
Total	116	339
Southeast:		
Alabama	43	129
Kentucky	9	69
Mississippi	34	72
Tennessee	24	103
Total	110	373
Mountain:		
Arizona	22	65
Colorado	34	98
Montana	3	17
Utah	14	29
Wyoming	1	3
Total	74	212
Pacific:		
California		298

*Less than 0.5 billion cubic feet. Source: Bureau of Mines.



Natural Gas Section

are affected by the changing proportion of various uses and by the rapid growth of sales in areas remote from the point of production. In 1952 the average price paid by consumers was about 33 cents per M.c.f. on all marketed production of 8 trillion cubic feet, including field use and other direct industrial sales, and 42 cents per M.c.f. on the smaller amount of 4.7 trillion cubic feet sold by natural gas utilities.

Residential prices paid by utility customers are about 75 cents per M.c.f., the same as in 1938, and some 20 per cent higher than in 1945. Much of the recent increase is due to the extension of service to new areas farther removed from the source of supply. In the areas of long-established substantial use by households, such as the Southwest and North Central states, the advance averaged less than 10 per cent from 1948 to 1952.

Transportation and local distribution services account for about 90 per cent of the residential price. Local distribution costs often run 50 cents or more per M.c.f. The investment required in facilities to meet peak loads, particularly for heating, and the corresponding low load factor, make this charge a large part of the total. It might well be billed as a fixed charge per month. The charge for transportation service varies widely with the length of the trunk line movement. For areas a thousand miles or more from the point of production it may represent over 20 per cent of the total price. Consumers would find it informative if their bills could be itemized in this manner, for in most cases they would find that gas itself accounts for only 10 to 15 per cent of what they pay, while the remainder is a necessary and reasonable charge for the services required to deliver the product to their homes.

A wide range of prices exists for industrial use of gas, depending again on distance from production and on other factors. Gas consumed in field operations of the petroleum industry and for making carbon black sells for less than 8 cents per M.c.f. on the average. Other industrial users pay higher prices, frequently from 15 to 40 cents per M.c.f., depending on the transportation cost involved, the amount and stability of the load, and whether delivery can be interrupted when the gas is needed to meet peak residential requirements.

Prevailing prices have made it attractive for many large firms, including some electric utilities, to use gas instead of other fuels. Considering heat content alone, without allowing for the higher

TABLE 5—PRICES PAID FOR NATURAL GAS

	Prices at Point of Consumption Reported by Bureau of Mines Cents Per M.c.f.						Prices Reported by Natural-Gas Utilities on Sales to Users Cents Per M.c.f.				
	Residential	Commercial	Field Use	Carbon Black	Other Ind.	Total	Residential	Commercial	Ind.	Other	Total
1936	73.3	48.1	4.6	1.3	17.2	22.0	71	47	16	18	32
1937	73.6	48.7	4.8	1.3	17.5	22.0	75	50	17	18	34
1938	74.2	49.2	4.5	0.9	16.8	21.8	75	49	16	21	34
1939	73.5	49.4	4.2	0.9	16.6	21.6	73	48	16	18	34
1940	71.1	47.8	3.8	1.0	16.7	21.7	72	48	16	15	34
1941	72.0	47.2	4.4	1.1	17.1	22.1	71	47	17	15	33
1942	70.7	43.7	4.2	1.3	17.1	22.7	68	44	17	14	33
1943	70.0	42.8	4.3	1.5	16.7	22.3	67	44	18	20	32
1944	69.1	41.7	4.3	1.6	15.9	21.5	66	43	17	23	31
1945	68.3	42.4	4.4	2.3	15.8	21.4	64	48	17	17	32
1946	67.6	42.4	4.6	3.0	16.0	22.0	63	49	17	19	33
1947	65.6	44.1	5.3	3.6	16.1	23.2	61	49	18	17	34
1948	65.3	44.0	6.0	4.7	17.2	24.1	64	47	19	17	34
1949	67.1	45.5	6.2	4.8	17.4	25.4	65	48	19	17	35
1950	69.0	47.6	6.2	4.8	17.6	26.6	68	51	20	18	37
1951	*76.0	52.9	6.8	5.2	19.2	29.8	70	54	21	21	39
1952	*83.1	57.0	7.8	5.5	20.7	33.2	75	57	22	20	42

*These averages are affected substantially by the influence of natural gas mixed with manufactured, particularly in New York and Pennsylvania, and apparently valued at the average price of the mixture. Adjustment of these averages to exclude the effect of mixed gas makes them comparable with the figures reported by utilities on natural gas sales to residential customers. Source: Bureau of Mines, American Gas Association.

TABLE 6—1952 NATURAL-GAS PRICES ON UTILITY SALES BY MAJOR GEOGRAPHIC AREAS

	Price in Cents Per M.c.f. by Class of Service				
	Residential	Commercial	Industrial	Other	Total
Middle Atlantic	96	86	42	73	73
South Atlantic	85	68	26	42	52
North Central*	75	62	31	24	52
Southwest*	61	41	13	11	21
Souhteast	71	50	22	22	35
Mountain	62	47	21	14	34
Pacific	67	53	30	26	48
Total U. S.†	75	57	22	20	42

*These areas have had a substantial use of gas for many years and are least affected by extension of service into new areas on a large scale. For comparative purposes, the prices in 1948 for these areas are listed below. †Includes small amount of consumption in New England.

	1948 Price in Cents Per M.c.f. by Class of Service				
	Residential	Commercial	Industrial	Other	Total
North Central	70	55	26	18	45
Southwest	56	37	10	13	19

Source: American Gas Association

AVERAGE GAS PRICES AT WELLS IN DIFFERENT PRODUCING AREAS

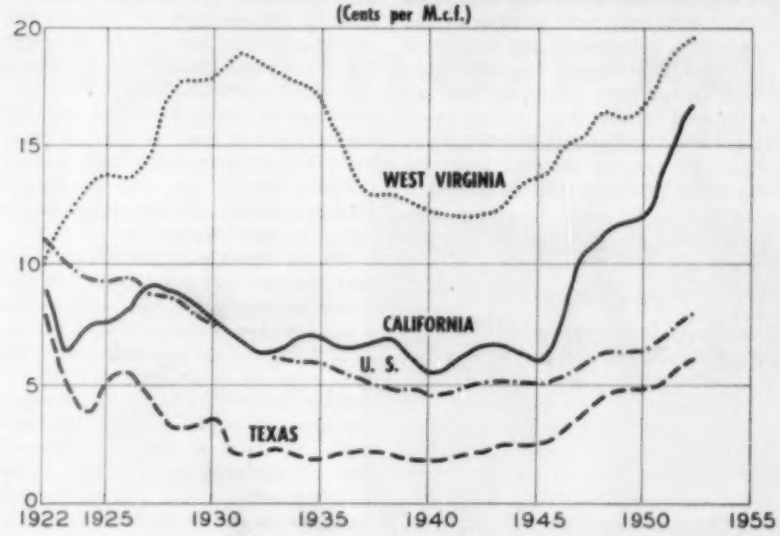


TABLE 7—AVERAGE GAS PRICES AT WELLS IN DIFFERENT PRODUCING AREAS

	Average Value at Wells, Cents Per M.c.f.			
	Southwest Texas	Pacific California	Appalachian West Virginia	United States
1922	8.0	9.0	10.0	11.1
1923	5.1	6.5	12.0	10.0
1924	3.8	7.5	13.5	9.3
1925	5.2	7.5	13.8	9.4
1926	5.7	8.2	13.6	9.5
1927	4.4	9.1	14.7	8.8
1928	3.4	8.8	17.6	8.9
1929	3.3	8.5	17.6	8.2
1930	3.6	7.5	18.0	7.6
1931	2.2	7.0	18.9	7.0
1932	2.2	6.5	18.5	6.4
1933	2.4	6.4	18.0	6.2
1934	2.2	7.0	17.6	6.0
1935	2.1	7.0	16.9	5.8
1936	2.3	6.5	14.8	5.5
1937	2.3	6.6	12.9	5.1
1938	2.2	6.9	13.0	4.9
1939	2.1	6.2	12.7	4.9
1940	1.8	5.6	12.3	4.5
1941	2.0	6.0	12.1	4.9
1942	2.2	6.6	12.2	5.1
1943	2.4	6.5	12.3	5.2
1944	2.5	6.4	13.3	5.1
1945	2.6	6.0	13.7	4.9
1946	3.0	7.4	14.9	5.3
1947	3.7	10.2	15.4	6.0
1948	4.5	11.3	16.7	6.5
1949	4.6	11.8	16.2	6.3
1950	4.7	11.9	16.8	6.5
1951	5.4	14.6	18.6	7.3
1952	6.2	16.7	19.6	7.8

Source: Bureau of Mines.

combustion efficiency and lower handling costs for gas, a price of 20 cents per M.c.f. is equivalent to fuel oil at about $1.20 a barrel and to coal at $5.00 a ton, which figures are generally well below the prices of these other fuels. In some areas, gas delivered for 35 or 40 cents can still find ample industrial markets. Demands have increased rapidly in response to this situation, with the result that gas prices are moving toward their proper competitive level with other fuels. This development must continue if demand and supply of the several major sources of heat are to be kept in balance. On this point we must consider also the realization by producers, as that is a major influence affecting new supply.

What can be realized for any fuel is determined by competition among all producers of natural gas, fuel oils, and coal. For each of these forms of energy there are at least hundreds of suppliers. They compete not only with each other in their own industry but also with the suppliers of alternative fuels. The record of the changing participation of coal, oil, and gas in the energy markets of the United States provides dramatic evidence of this constant struggle.

Measuring price at the well or mine in cents per million British thermal units for comparability, we find the following interesting facts:

1. Bituminous coal and natural gas are consistently cheaper than crude oil and anthracite coal.

2. They sold at about the same level from 1923 to 1933, but thereafter coal showed a steady upward trend while natural gas remained at lower levels.

3. At around 7 cents per million B.t.u., gas sells at the well for only about 35 per cent as much as bituminous coal at the mine and only about 16 per cent as much as crude oil.

As is often the case, averages do not tell the full story in this instance. Substantial variations exist in field prices in different areas, as shown by the statistics in Table 7. At the well, gas sold in 1952 for an average of only 6 cents per M.c.f. in Texas, compared with about 15 cents in California and 20 cents in West Virginia. The national average was only about 8 cents because of the large quantities sold at low prices in the southwestern producing states. Producers in these areas are handicapped by being far from the major fuel-consuming areas. In many cases they are also selling gas under long-term contracts negotiated at depression price levels that do not reflect current costs or conditions. Newer contracts are generally at much higher figures than the averages, and the increasing quantity of such sales is raising the average.

The demand for natural gas under existing circumstances will continue to produce an upward trend in its price until a competitive balance is attained. The circumstances which resulted in this convenient fuel selling at ridiculously low prices were temporary and no longer exist. Extraordinary discoveries of oil and gas in the period from about 1926 brought about a temporary surplus. Markets were not immediately available for the greatly increased supplies. In order to find some outlet and to protect their properties against drainage by others, many producers were forced to accept extremely low prices

for natural gas on long-term contracts. Price controls acted to maintain this condition from 1941 through 1945.

Postwar developments have entirely altered the situation. As the price of other fuels increased and transportation technology improved, scores of new gas lines were built to carry this convenient fuel to millions of additional customers. Demand jumped by leaps and bounds and a major part of the available reserve was tied up in long-term contracts. With prices still relatively attractive to customers, much larger demand may be anticipated. These increasing requirements cannot be met unless price provides sufficient incentive to bring about a corresponding rise in discovery of new gas and in proved reserves. It is unrealistic to expect gas to continue underselling its principal competitors. Average field prices of about 20 cents per M.c.f. on new gas contracts will probably be required to balance supply and demand so long as other fuels remain at their present prices. Individual contracts will continue to be made for prices below and above such average, depending on location and other competitive factors.

Even if the average price of all gas sold at the well were to rise to 20 cents per M.c.f., which could only take place over a very long time because of the tremendous volumes already committed at lower prices under long-term contracts, energy from gas would still sell at the well for less than half as much as crude oil currently. Under present prices, the revenue received from gas and crude oil by producers is in the ratio of 1 to 10 while the energy content of their production is in the ratio of 6 to 10.

Future Outlook

A remarkable expansion has occurred in the natural-gas industry in the postwar period. Customers and sales have more than doubled in only 7 years. Additional rapid growth will no doubt continue unless field prices are arbitrarily prevented from reflecting competitive economic forces. There are still many customers eager to be supplied with this convenient fuel in areas where its introduction has been quite recent or is only now being planned. Their demands can be met only in part from present reserves, but they can be satisfied fully from increases in reserves that may be expected to occur if field prices remain free of artificial regulations.

Natural gas may in time surpass coal and even challenge crude oil as the principal domestic source of energy. This possibility seems quite real considering the strength of current and probable future demands for gas. The proportion of residential users of gas is apt to increase along with income and standards of living. Industrial use will also expand so long as gas can meet the prices of competitive fuels. Consequently, demand can only be considered as a most favorable factor in the future of this industry.

On the supply side, there is evidence that reserves and production will increase as required to meet demand for a considerable future period unless arbitrary regulation interferes with the field price of natural gas and thereby reduces the ability of price to stimulate the necessary exploration and development. As usual, purchasers of natural gas will naturally seek to buy at the lowest possible prices and sellers will endeavor to secure the best realization they can in a competitive situation. So long as these opposing forces are allowed to operate effectively, supply and demand will be balanced and the interests of consumers will be protected with respect to both price and availability over the long-term.

It may well be expected that the rate of growth of the gas industry may slow down below the remarkable percentage gains of recent years.

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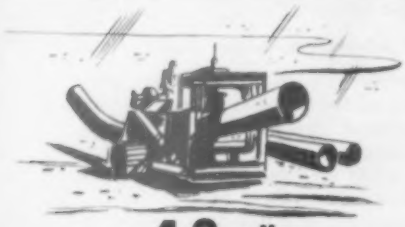

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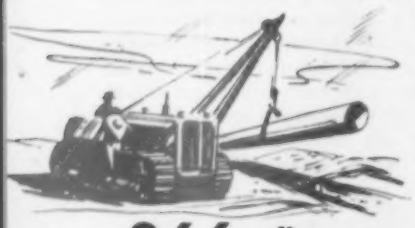

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How Pooling Can Improve Pipeline Efficiency

. . . by eliminating wasteful duplication of facilities

by Paul Reed
Pipeline Editor

CURRENT trends toward pooling of pipeline operations in certain strategic areas are parallel to familiar railroad practices. Car pools and joint use of terminal facilities have been long established in railroading to get economies resulting from greater flexibility and from elimination of wasteful duplication.

Since pooling of facilities has been advantageous in the pipelining of natural gas, refined products, and crude oil it may be predicted that pooling or joint ownership practices will be extended in future planning for lower-cost transportation and transmission.

Of much significance is the pooling now employed by gas utilities in the Philadelphia, New Jersey, and New York area. There three entirely separate grid systems now function as pooled terminals for natural gas.

1. The most important of these is operated under the name of New York Facilities Agreement which provides for operation of certain interconnected terminal lines of Consolidated Edison Co., Inc., Brooklyn Union Gas Co., and other utilities in the New York and Brooklyn area. Into these terminal grid lines, natural gas is fed from the transmission system of Transcontinental Gas Pipe Line Corp. If authorized in present proceedings, Tennessee Gas Transmission Co. would also feed the grid. Texas Eastern Transmission Corp. has lines for delivering gas in the area.

2. A similar terminal pooling of lines functions in New Jersey in connection with Public Service Electric & Gas Co. and other local companies. The New Jersey pool is served by both Transcontinental and Texas Eastern.

3. Philadelphia Electric Co. and the Philadelphia Gas Works Division of United Gas Improvements Co., have joined in the operation of terminal lines in the Philadelphia area.

It is conceivable that the advantages of pooling gas terminal facilities might be extended in the future so that the three existing terminal pools would be joined in a big pool which would also include the transmission trunk lines located in the area from Philadelphia to New York. Operation of the lines involved could be handled either by a corporation which might acquire such Philadelphia-New Jersey-New York delivery facilities or by a pooling of lines under an administration which would charge the utilities and pipelines in proportion to services.

It would be likely that such a Philadelphia-New Jersey pool would be dominated by the utility companies of the area receiving the gas rather than by the pipeline systems transmitting from the Southwest.

Economies of a Gas Grid

Future construction of belt lines and interconnecting grid lines could be planned so as to substantially increase the benefits of the pool. The objectives might be indicated as follows:

1. Duplication of expensive lines could be avoided in metropolitan areas where construction costs commonly run two to three times what they are elsewhere.

2. Fuller advantage could be taken of large-diameter economies.

3. New lines could be laid over shorter routes in many cases. Belt lines could be built to increase the flexibility of supply to all utilities involved.

4. During peak loads the over-all flexibility of the big terminal pool would give better service to gas-utility customers.

The ultimate effect of a Philadelphia-New Jersey-New York pool could contribute to the competitive position of natural gas by restraining the rise of delivery costs. The consumer would benefit and the growth of the market for natural gas would be facilitated.

Since the Philadelphia-New Jersey-New York area is the largest potential outlet for Gulf Coast gas, the development of this market is vital for the future of producers who would naturally profit by sale of larger volumes at reasonable field prices.

Conditions in the Baltimore and Washington, D. C., area might be also favorable for a similar terminal gas pipeline system.

Advantages to the Public

Furthermore, in wartime the function of pooled terminal gas lines would be essential for national defense effort. Under any emergency conditions they would give the best assurance of continuity of service.

Basically it is a further extension of "displacement" long practiced by natural-gas systems. "Interconnections between companies are desirable in the public and private interest," said Carl T. Kallina, chief, division of gas certificates. Federal Power Commission, at the meeting this year of the Operating Section of the American Gas Association in New Orleans.

Chicago Example

At Chicago the advantage of a natural-gas-terminal-pipeline system has been exemplified for more than two decades by the Chicago District Pipe Line Co. system built in the early 1930's to deliver gas from Natural Gas Pipeline Co. of America to Peoples Gas Light & Coke Co. and to several other utilities which have subsequently been absorbed by Peoples. In recent years it has also been delivering gas from Texas Illinois Natural Gas Pipeline Co.

Railroad Terminaling

The application of terminal operation in railroading can be observed at Houston where the Houston Belt & Terminal Railway Co. handles cars for six railroads which would face intolerable duplication and congestion if each road attempted to have separate trackage in that metropolitan city.

Railroad terminaling at Chicago is largely handled by Indiana Harbor Belt Railroad Co. with inner and outer belt-

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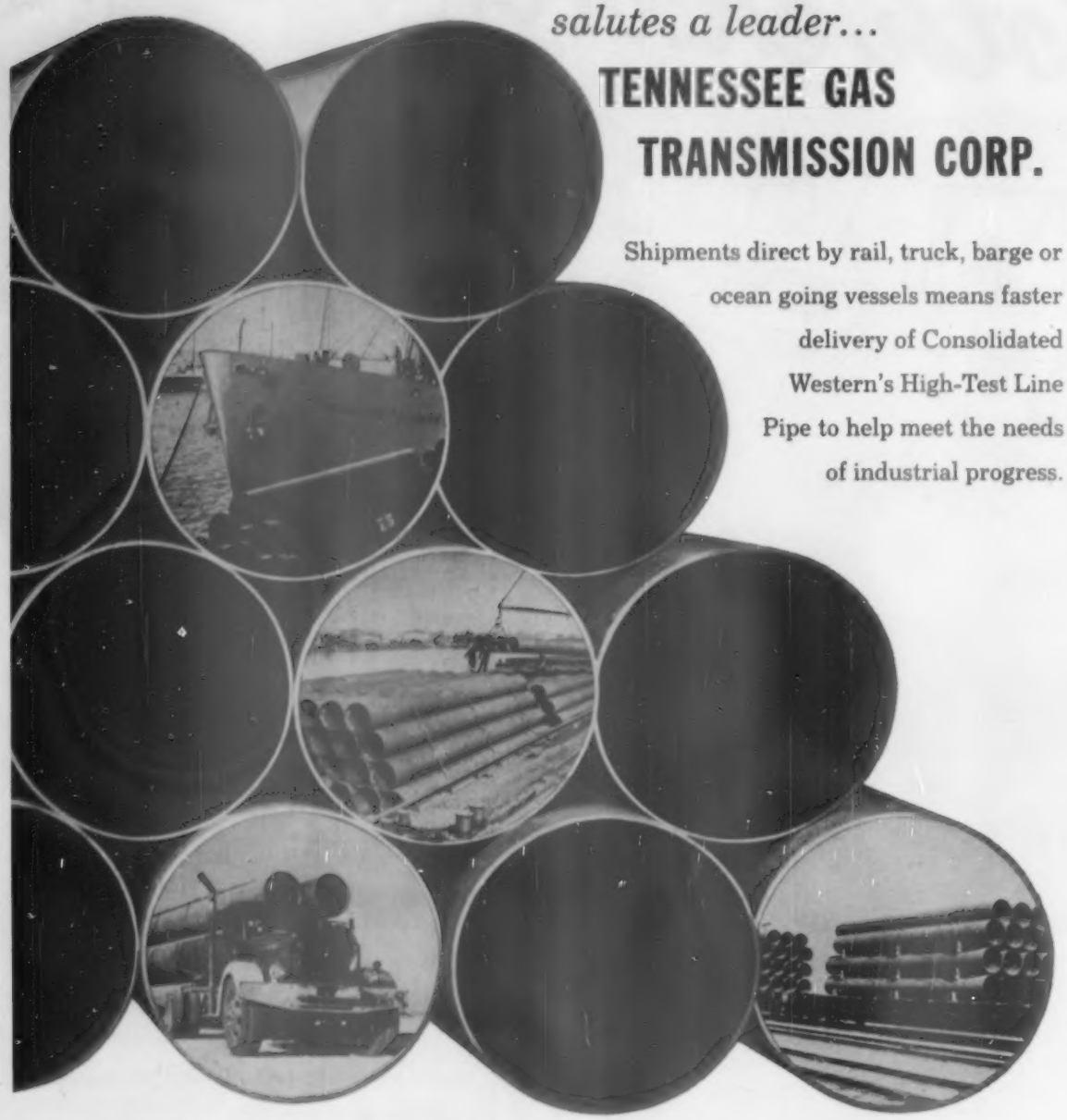

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line railroads. These serve the area in and around Chicago and extend even to Gary, Ind.

Products Pipelines

Paris, France, has a products belt line that nearly encircles the city to serve delivery points. This is the system of Societe des Transports Petroliers par Pipe Line which is jointly owned by several refining companies and the French Government. This system is probably the outstanding example in products pipelining of a system owned and operated for the mutual benefit of several interests serving a large metropolis.

The Paris terminal belt line was originally intended to be an extension of a single trunk line from Le Havre to Paris. Within recent months, the company has arranged to operate the products line projected by the United States Government from St. Nazaire to Melun and Metz, France.

There are numerous examples in the United States of several companies joining in the ownership of products pipelines. Notable among these are Great Lakes Pipe Line Co., Plantation Pipe Line Co., Bayou Pipe Line System, Wyco Pipe Line Co., Evangeline Pipe Line System, Wolverine Pipe Line System, Yellowstone Pipe Line Co., and Harbor Products System.

Crude-Oil Pipelines

Crude-oil pipelines that are owned by more than one company include Texas-New Mexico Pipe Line Co., Texas-Empire Pipe Line Co., Kaw Pipe Line Co., Ajax Pipe Line Co., Basin and Ozark Pipe Line Systems, Platte Pipe Line Co., Rancho Pipe Line System, and West Texas Gulf Pipe Line Co.

In the postwar period there has been a conspicuous increase in products and crude-oil pipelines owned jointly by more than one company. The economies of large-diameter pipe and the reduction of expense in handling larger volumes make it possible to undertake pipeline projects that would not be profitable if each of the participants had to build a separate system.

Joint ownership of crude-oil gathering lines has been frequently advocated but with few exceptions, this has not been practiced. However, some of the effects of results from united ownership have been achieved by consolidation of gathering lines through transfer by sale of gathering systems.

Conclusion

Pooling of the terminal lines would probably be more promising for the natural-gas facilities in the Philadelphia-New Jersey-New York area than it would be for petroleum lines in any metropolitan area. This is because of the following conditions:

1. Gas is piped all the way to the burner tip. On the other hand, in products transportation it still appears to be generally more economical to truck petroleum products from bulk stations to filling stations than to pipe gasoline through city streets.

2. Gas demand has great fluctuations due to the changes in atmospheric temperatures which require flexibility and large reserve capacity for meeting peak loads.

3. Natural gas because of its characteristics can be readily exchanged and accounted for between one company and another.

The situation of natural-gas transmission in the Philadelphia-New Jersey-New York area is unique because of the number of transmission pipelines and utilities involved and the magnitude of the potential market which might be more effectively developed with the aid of pooled terminal grid and belt lines. It looks as though nobody could lose by pooling there and as though everybody would gain—including the Gulf Coast gas producers.

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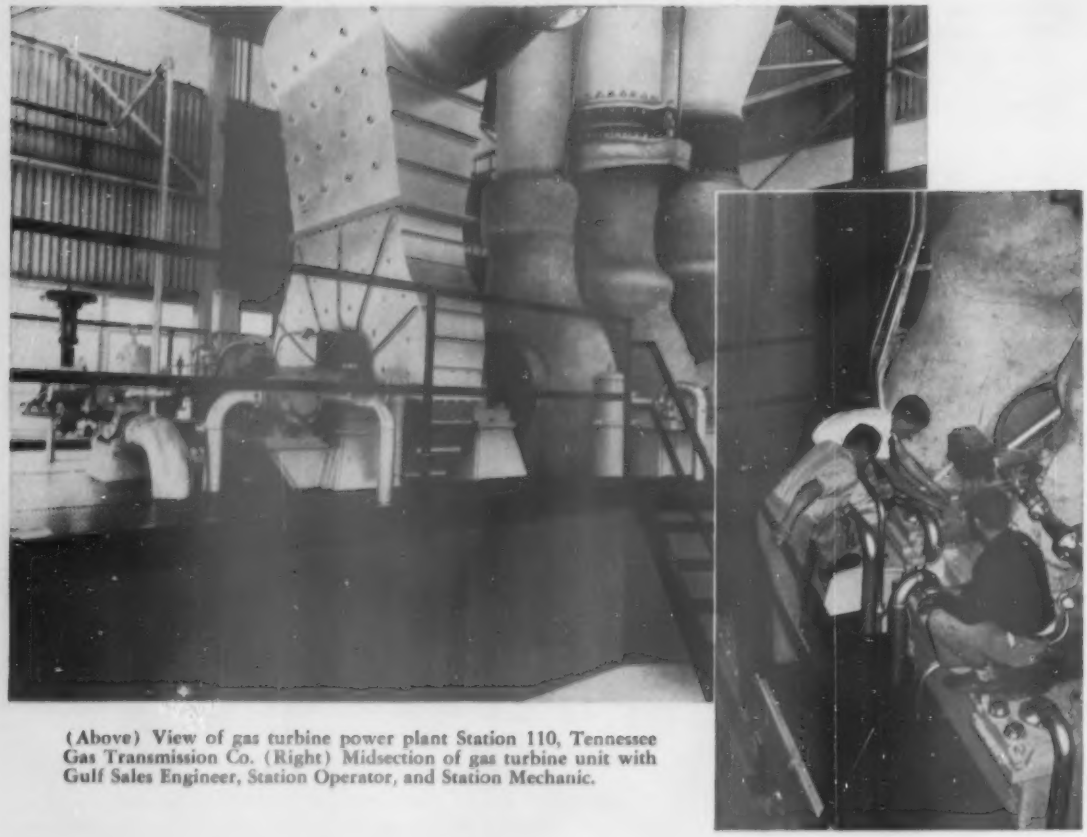

(Above) View of gas turbine power plant Station 110, Tennessee Gas Transmission Co. (Right) Midsection of gas turbine unit with Gulf Sales Engineer, Station Operator, and Station Mechanic.

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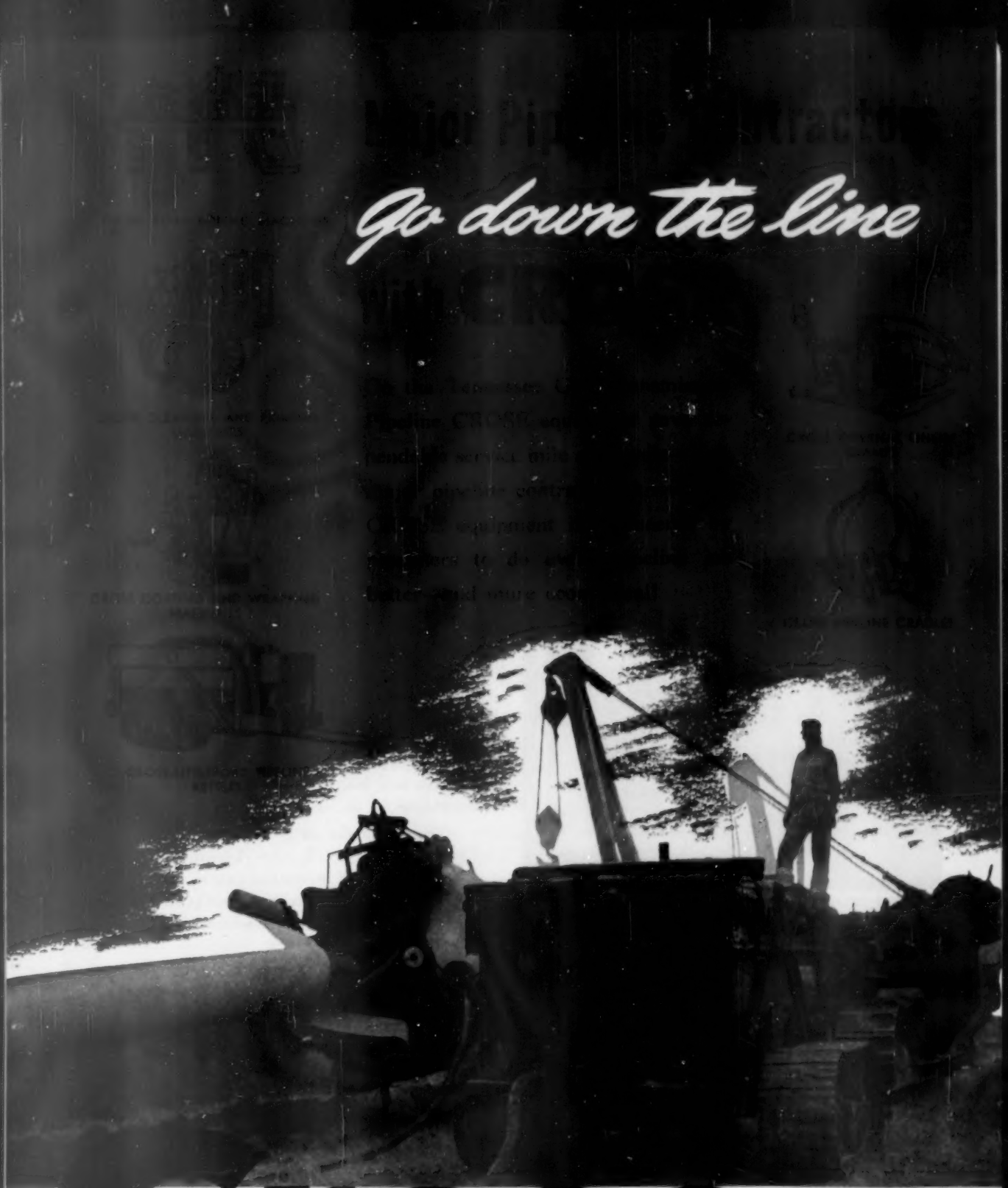

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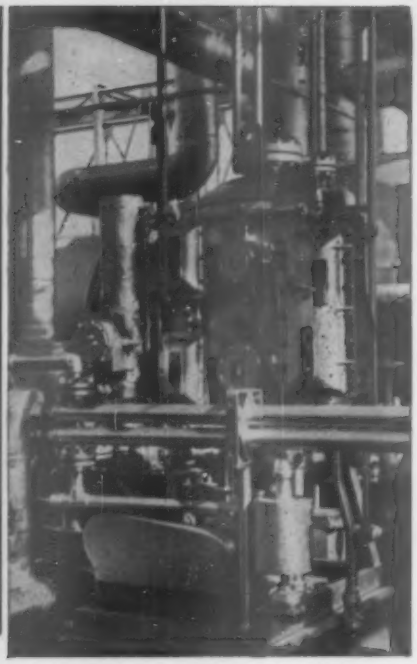
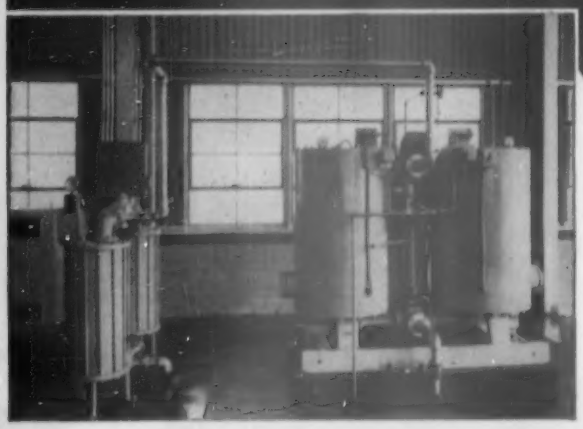




Lectrodryers can dry air and gases to dewpoints lower than – 100° F. They can reduce relative humidity to lower than 10%, even in large areas. Also, they can reduce the moisture content of organic liquids to as low as 3 or 4 parts per million. There are Lectrodryers working with pressures as high as 6,000 psi.

The complicated equipment in the top picture might have been impossible 22 years ago! It's a Lectrodryer* drying propane at the TGT plant in Gabe, Ky. Such special drying equipment is possible today because of the wealth of application know-how we have built up over 22 years. That's how long we've been solving moisture problems for the oil and gas industry.

The instrument air Lectrodryer in the lower picture is at TGT, too—keeping harmful moisture out of instrument air in the plant. (Good insurance to have!) It's one of our standard dryers, proved to be the solution to so many moisture problems.

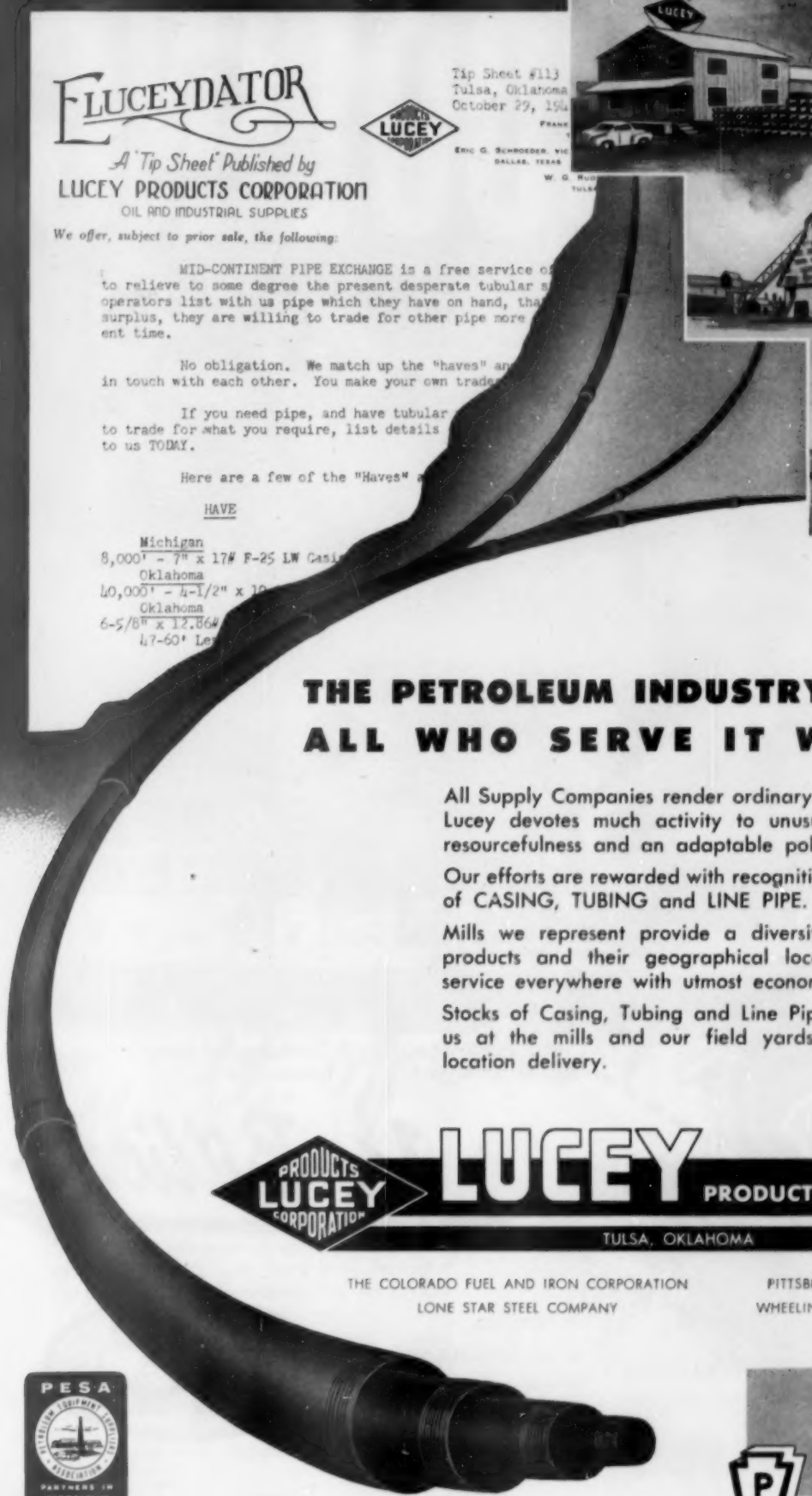
When you need dry air, gas or organic liquids, our engineers will work with you and recommend the proper Lectrodryer to do the job best, even if we must build it special. Write today and request the booklet *Because Moisture Isn't Pink*. It describes the many ways that industry has put Lectrodryers to work. Pittsburgh Lectrodryer Corporation, 325 32nd Street, Pittsburgh, Pa.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

*REGISTERED TRADEMARK U. S. PAT. OFF.



FLUCEYDATOR

A "Tip Sheet" Published by

LUCEY PRODUCTS CORPORATION

OIL AND INDUSTRIAL SUPPLIES

Tip Sheet #113
Tulsa, Oklahoma
October 29, 194

We offer, subject to prior sale, the following:

MID-CONTINENT PIPE EXCHANGE is a free service o
to relieve to some degree the present desperate tubular s
operators list with us pipe which they have on hand, tha
surplus, they are willing to trade for other pipe more
ent time.

No obligation. We match up the "haves" an
in touch with each other. You make your own trade

If you need pipe, and have tubular
to trade for what you require, list details
to us TODAY.

Here are a few of the "Haves"

HAVE

Michigan
8,000' - 7" x 17# F-25 LW Casi
Oklahoma
40,000' - 4-1/2" x 1
Oklahoma
6-5/8" x 12.86#
47-60' Le

THE PETROLEUM INDUSTRY REWARDS ALL WHO SERVE IT WELL . . .

All Supply Companies render ordinary services. In addition, Lucey devotes much activity to unusual services requiring resourcefulness and an adaptable policy.

Our efforts are rewarded with recognition as a major supplier of CASING, TUBING and LINE PIPE.

Mills we represent provide a diversity of quality tubular products and their geographical locations assure prompt service everywhere with utmost economy.

Stocks of Casing, Tubing and Line Pipe are maintained by us at the mills and our field yards, affording direct-to-location delivery.

PRODUCTS LUCEY CORPORATION

LUCEY PRODUCTS CORPORATION

TULSA, OKLAHOMA

THE COLORADO FUEL AND IRON CORPORATION
LONE STAR STEEL COMPANY

PITTSBURGH STEEL COMPANY
WHEELING STEEL CORPORATION

PESA
PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION
PARTNERS IN PETROLEUM PROGRESS

WHEELING STEEL

P CF&I L S S

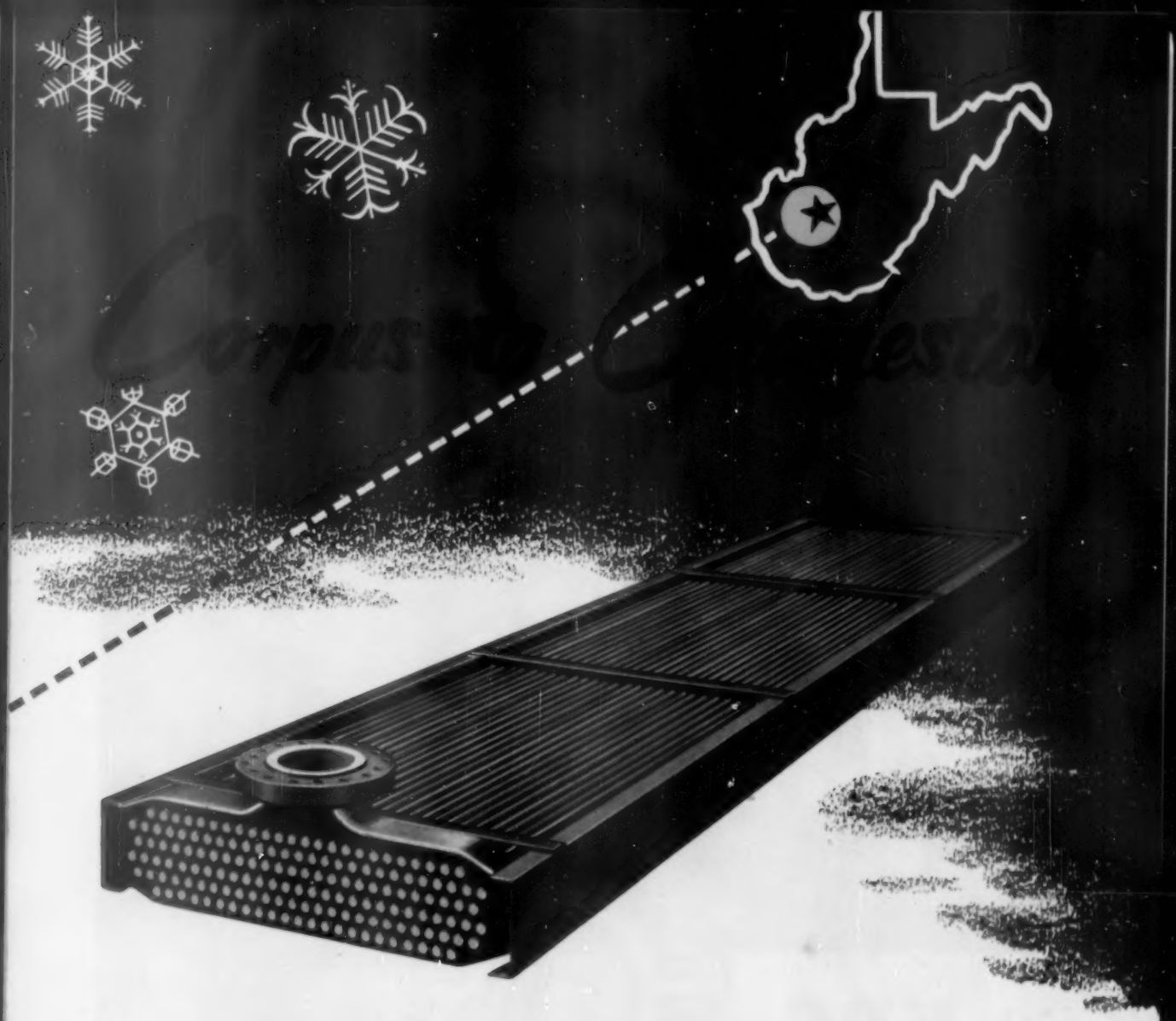
GAS COOLING

Pictured above is Tennessee Gas System's Compressor Station No. 3 at Fostoria, Texas.

1½ Billion ...

- REFINING
- MANUFACTURING
- PIPELINE
- CHEMICAL PROCESSING

WESTERN SUPPLY CO.



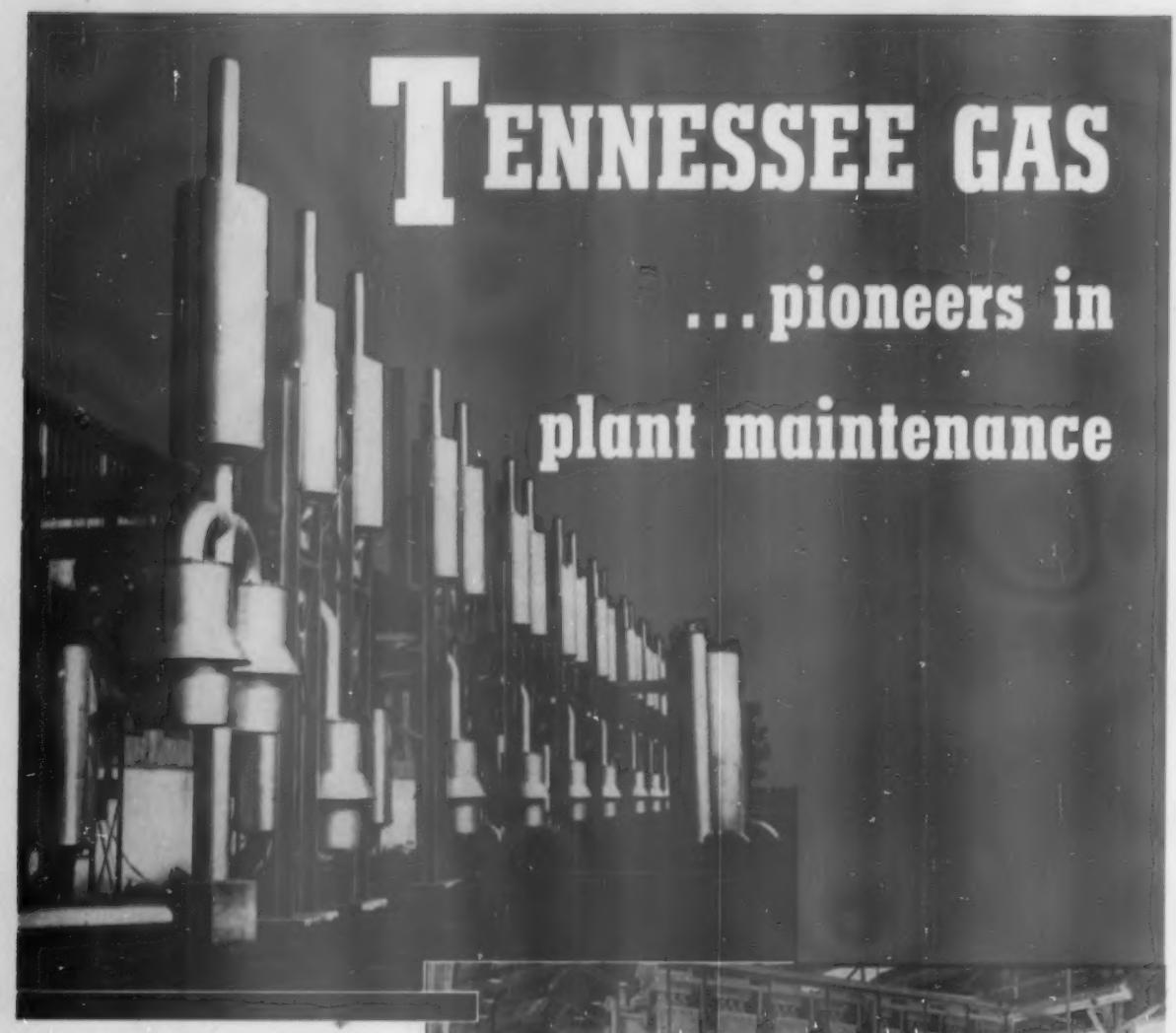
Cu. ft. of GAS Per Day

Approximately one half million square feet of Western high pressure gas coils and Western jacket water coils have been furnished Tennessee Gas Transmission for its system.

Here, as in refineries, gasoline plants, chemical processing plants and pipelines throughout America, Western heat transfer equipment has an important function in a project of major significance, and performs that function with dependability.

WESTERN
HEAT EXCHANGERS

Manufactured by
WESTERN SUPPLY COMPANY
P.O. BOX 1888 TULSA, OKLAHOMA



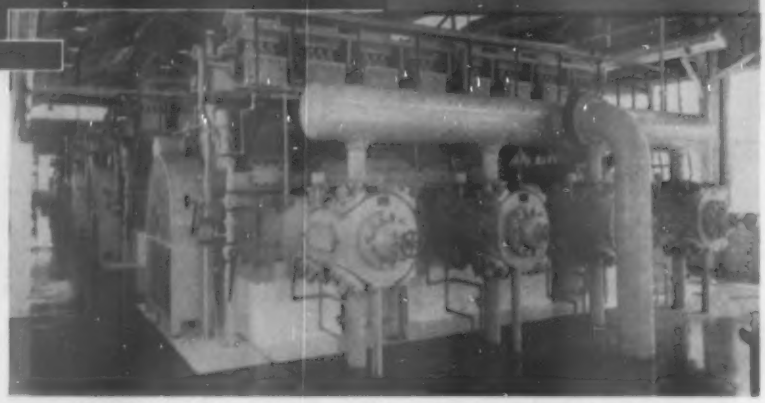
TENNESSEE GAS

...pioneers in plant maintenance

with KPC paints

For maximum protection and lasting beauty, Tennessee Gas Transmission Company has standardized on Kansas Paint and Color Company Silicone Aluminum Paint for hot surfaces.

Interior or exterior, hot or cold surfaces, Kansas Paint and Color paints assure top quality and performance throughout the petroleum industry.



(Top) Compressor Mufflers at Greenville, Mississippi, station of Tennessee Gas Transmission Company, finished with HR-25 Silicone Aluminum.

(Below) Tennesee Gas and Transmission Company's Engine Room, C Building, Monroe, Louisiana, finished with Kansas Paint and Color Company enamels.

KANSAS PAINT & COLOR COMPANY

The Kansas Paint & Color Company

132 NORTH MOSLEY • WICHITA, KANSAS

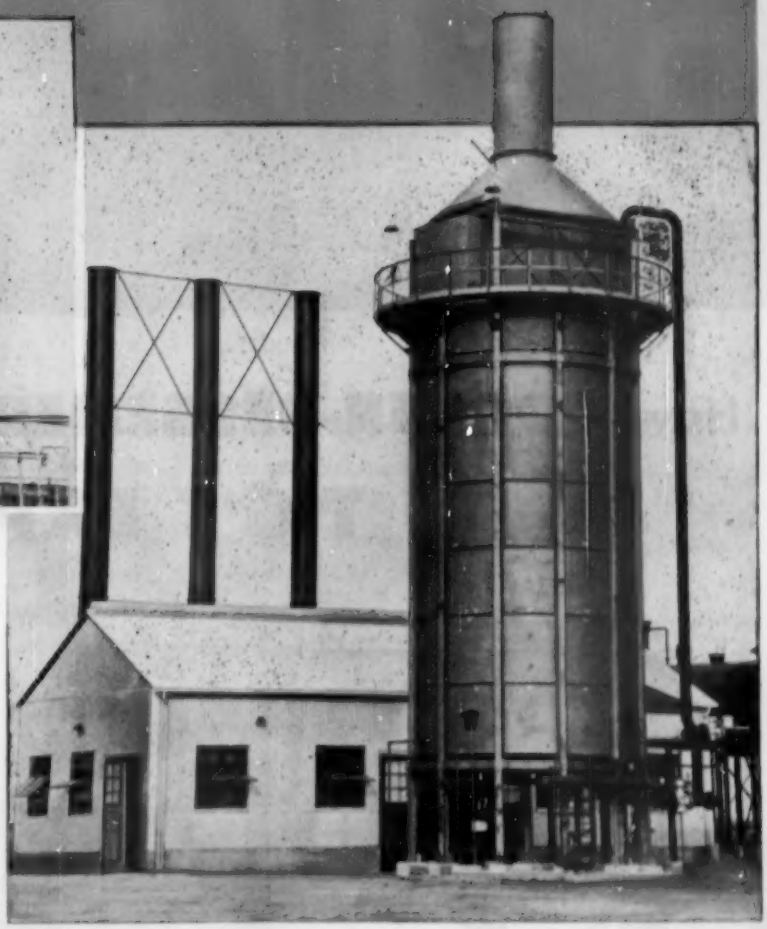
providing ✓ HIGH THERMAL EFFICIENCIES

✓ LOW FUEL CONSUMPTION

for TENNESSEE PRODUCTION COMPANY

(Subsidiary of Tennessee Gas Transmission Company)

Struthers Wells FIRED HEATERS



Three Struthers Wells oil heaters as installed in gasoline plants of the Tennessee Production Company, a subsidiary of Tennessee Gas Transmission Company. These heaters were installed on successive jobs, testifying to satisfactory performance. The two smaller heaters in the insert were installed first, and the largest heater represents the most recent unit.

High thermal efficiencies and good performance are characteristic of Struthers Wells heaters, and a large number of recent installations indicates the acceptance of this equipment in gasoline plant work.

Struthers Wells

STRUTHERS WELLS CORPORATION

WARREN, PA.

Plants at Warren, Pa. and Titusville, Pa. • OFFICES IN PRINCIPAL CITIES

(910-A) — Shown here are a few of the twenty-nine GMV's at the Batesville, Miss., station of Tennessee Gas. In addition to these 1000 hp Cooper-Bessemers, there are three 8-cylinder, 2000 hp GMW's - all delivering gas in volume well above their performance guarantee.

How **COOPER-BESSEMER** power progress meets the **T·G·T EXPANSION**

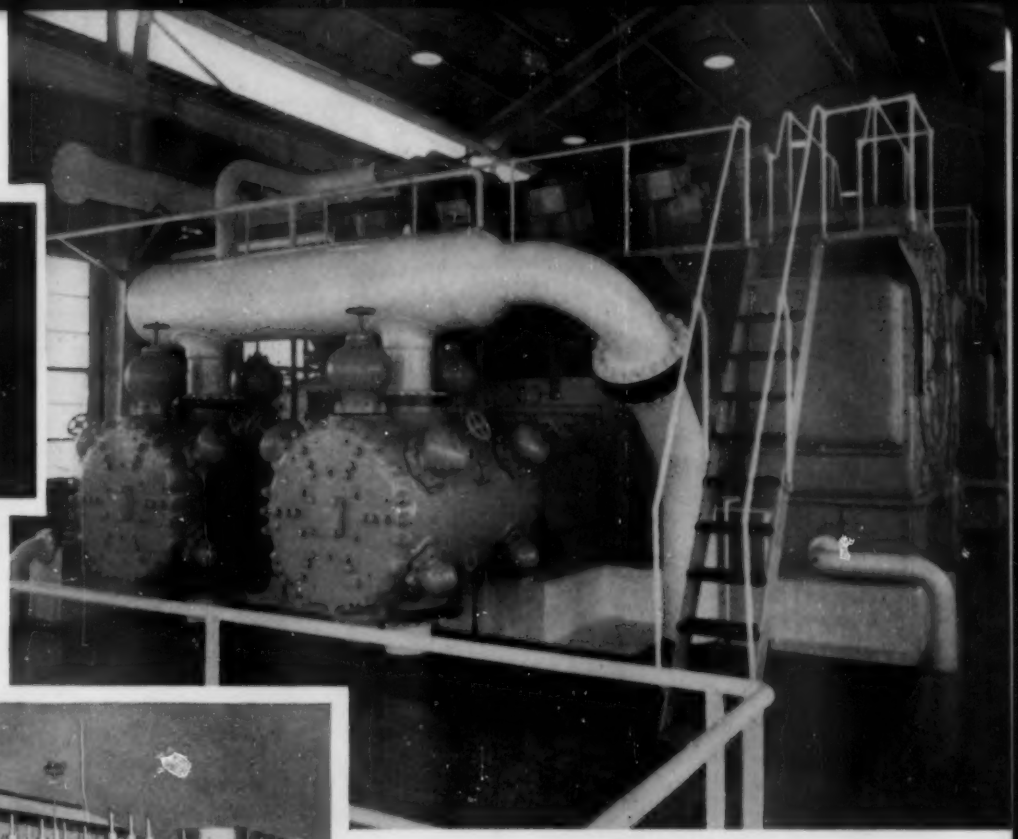
(933-A) — Main compressor building of the Cooper-Bessemer powered Batesville, Miss., station - another important addition to the huge expansion program of Tennessee Gas.

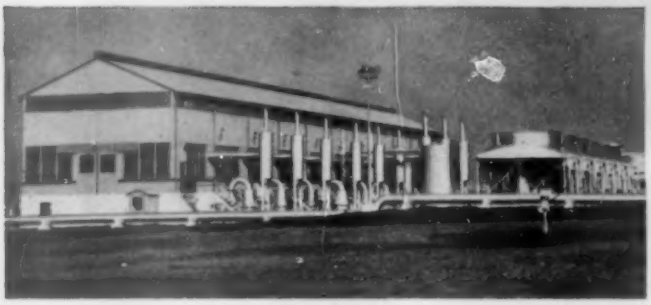
ANGLE V

Compressors

New York Washington, D. C. Bradford, Pa.
San Francisco, Cal. Houston, Dallas, Greggton, Pampa and Odessa, Texas Seattle, Wash.

Another Example of Efficient Power at Lower Cost





(909-A) — Exterior view of Portland, Tenn., pumping station showing exhaust setup and pipe line manifolding.

(1028-A) — Close-up of the compressor cylinders on one of the three 2000 hp GMW V-angle units in operation at the Portland, Tenn., station of Tennessee Gas Transmission. A total of thirty Cooper-Bessemers comprise this large installation.

WHEN the Tennessee Gas Transmission Company's first line was completed in 1944, Cooper-Bessemer 1000 hp GMV's furnished more than half of the system's entire compressor horsepower — the nation's first major pipeline powered with angle compressors exclusively. Since then many more Cooper-Bessemer V-angles have been added — the bulk of them GMV's. And throughout its history, this huge line has always exceeded its design capacity.

Today, the GMVA and GMWA, Cooper-Bessemer's latest V-angle compressor developments, offer unmatched power-to-space advantages. Add to this better-than-ever fuel efficiency with reduced heat load, and you can appreciate why and how TGT and other lines benefit so much by Cooper-Bessemer progress in compressor power.

Right now Cooper-Bessemer has further new developments underway that give every promise of still better things to come. So, to best meet compressor requirements today, *and* tomorrow, weigh the value of proved performance and progress such as this TGT example . . . and by all means check with Cooper-Bessemer on the very latest ways to cut the over-all cost of compressor service.

by **Cooper-Bessemer**

MOUNT VERNON, OHIO AND GROVE CITY, PENNA.

Tulsa · Shreveport · St. Louis · Los Angeles · Chicago

Did you ever put a **Pipe Line** *to bed?*

You Probably Haven't. But once a pipeline is "put to bed," a better life is in store for millions of Americans . . . all because a new "underground highway" has been pushed through swamps, rivers, over plains and mountains.

At remote production areas these carriers pick up "underground cargoes" of oil, water, gasoline, and natural gas. At far-away places these "cargoes" create new industries, breathe new life into old ones, and bring added convenience to the daily lives of Americans.

Western Pipeline Constructors, Inc., has set a new standard of dependability for those who must have a constant supply of these priceless "underground" cargoes.

PIPE LINE WESTERN DALLAS, TEXAS CONSTRUCTORS

James P. Neill, President — *Chas. S. LeNoir*, Vice-President — *E. G. Morrison*, Secretary

LOCKHART BUILDING • AUSTIN 2, TEXAS

CROUSE-HINDS

Hazardous areas in this plant are lighted by Crouse-Hinds EV Series Explosion-Proof and Raintight Lighting Fixtures

Explosion-Proof LIGHTING FIXTURES

. . . EXCEED the requirements for service in highly explosive atmospheres

To be safe for use in such locations, the fixture must operate at a temperature below the ignition temperature of the gas-air or vapor-air mixture. Also, the fixture must be so strong that it will resist internal explosions without damage and so tight that it will prevent the escape of flames or burning gases which might ignite the surrounding atmosphere.

Crouse-Hinds EV Series explosion-proof and raintight industrial lighting fixtures meet all of these requirements PLUS a wide margin of safety for extra protection.

Complete listings are in Crouse-Hinds Condulet Catalog.

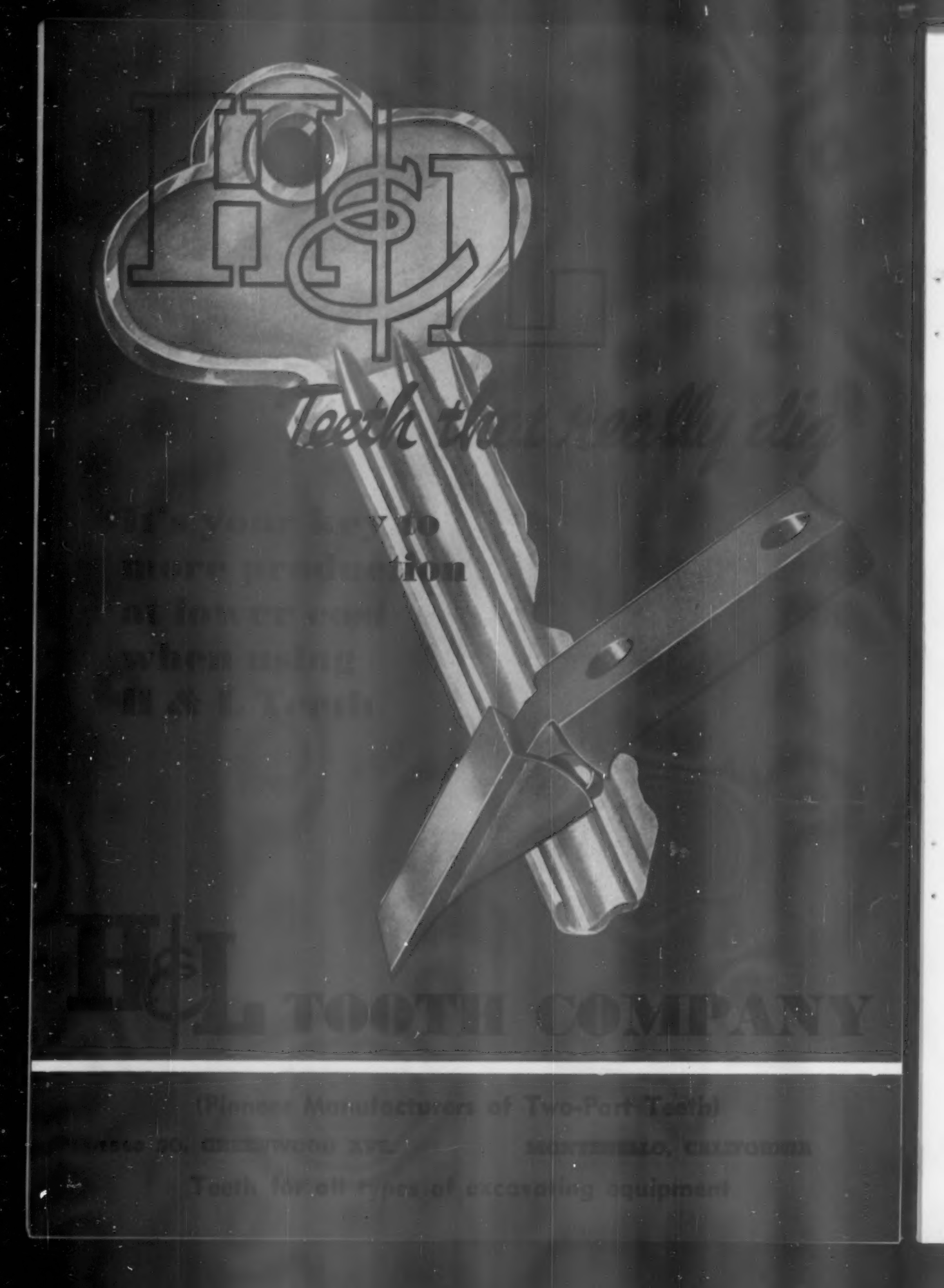
Crouse-Hinds offers a complete line of explosion-proof and dust-tight lighting fixtures for use in hazardous locations where fluorescent lamps are desired.

CROUSE-HINDS COMPANY
Syracuse 1, N. Y.

OFFICES: Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston — Indianapolis — Kansas City — Los Angeles — Milwaukee — Minneapolis — New Orleans — New York — Philadelphia — Pittsburgh — Portland, Ore. — San Francisco — Seattle — St. Louis — Tulsa — Washington. RESIDENT REPRESENTATIVES: Albany — Atlanta — Baltimore — Charlotte — Corpus Christi — Richmond, Va. — Shreveport
Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.

A Nationwide Distribution Through Electrical Wholesalers

CONDULETS • TRAFFIC SIGNALS • AIRPORT LIGHTING • FLOODLIGHTS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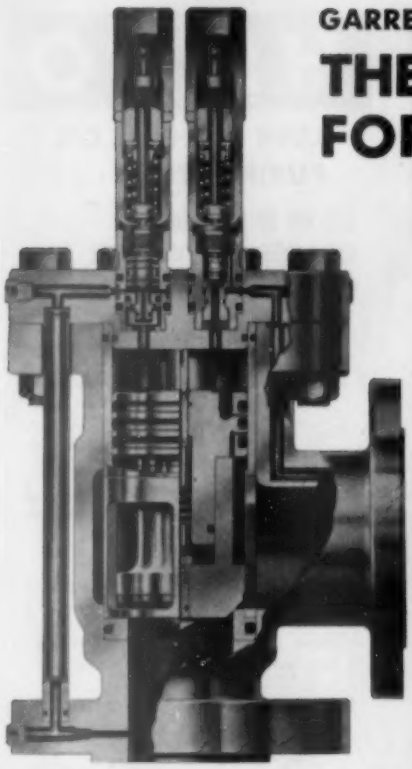


Garrett Relief Valves are tested and approved in accordance with ASME Boiler Construction Code, Section VIII, Unfired Pressure Vessels.

GARRETT RELIEF VALVES:

THE ULTIMATE IN PROTECTION FOR ALL PRESSURE SYSTEMS

No overpressure or accumulation required for full relieving capacity . . . spread between opening and closing pressure can be held from as little as 1% of system pressure up to complete blowdown . . . accuracy of set pressure and re-set pressure maintained over unlimited cycles . . . no limitation on back pressure: These are a few of the reasons why major transmission companies protect their systems with Garrett Relief Valves.

Patented features free the Garrett Relief Valve from dependency upon the velocity component of total pressure . . . *static pressure alone* determines when the valve will open, how long it remains open, and when it will close. Opening and closing movement of the plunger is pressure-cushioned to prevent damage from impact, and is complete in both directions . . . there is no possibility of wire-drawing or chatter even when system pressure is close to the set pressure of the valve.

Furnished with metal seats, or with a completely new design of soft seat, Garrett Relief Valves are available in all sizes from 1″ through 8″, with flanged or screwed connections, for pressures from 10 psi to 3000 psi. Immediate delivery can be made in most sizes.

Write today for complete information and learn why the Garrett Relief Valve offers more protection for your pressure systems.

GARRETT OIL TOOLS, INC.

Plant and Office
Box 2427 Longview, Texas

Sales Office
Box 6115 Houston, Texas

got

STEEL FABRICATION HEAVY HARDWARE

We are extremely gratified to have been selected to furnish and fabricate Compressor Building steel for so many Tennessee Gas Transmission Company Stations. Our first delivery was in 1947 and we now have furnished some steel at almost every station on the Line.

We believe this definitely indicates our ability to deliver correctly designed and fabricated material at equitable prices.

We respectfully solicit inquiries on almost any type of fabricated steel requirement. Brochure will be mailed upon request.

WATKINS INC.

711 WEST SECOND

P. O. BOX 117

WICHITA 1, KANSAS

TENNESSEE GAS TRANSMISSION COMPANY

The first of two compressor stations built for this client by Tellepsen at Monroe, Louisiana.

TRUSTWORTHY

. . . that's Tellepsen

Tennessee Gas Transmission Company is among many distinguished names on the roster of our "repeat" clients . . . gratifying evidence that Tellepsen Petro-Chem Constructors are worthy of your trust in the engineering and construction of plants and facilities for the petroleum, natural gas and chemical industries.

Your inquiry will be received in strictest confidence, without obligation . . . and with appreciative attention.

TELLEPSEN

PETRO-CHEM CONSTRUCTORS

Contractors and Engineers

A DIVISION OF TELLEPSEN CONSTRUCTION COMPANY

P. O. BOX 2536 HOUSTON, TEXAS, U. S. A.

HILCO

LUBE and FUEL OIL PURIFICATION . . .

GET RID OF DIRTY OIL . . .
GET LOWER OPERATING COSTS
LONGER EQUIPMENT LIFE

HILCO oil purification means complete oil purification! With a HILCO you get removal of sludge, acids, carbon, water and fuel dilution economically and efficiently. HILCO operation is continuous, all-electric and automatic.

Clean oil at all times reduces down time, increases production and HILCO units pay for themselves in savings.

HILCO offers a wide range of oil purification units . . . one to meet your needs. Write us about your equipment . . . and get recommendations at no obligation.

● *THERE'S A* **HILCO** *FOR EVERY LUBRICATION AND FUEL OIL FILTERING PROBLEM*

Oil Reclaimer

HILCO has 25 years experience in oil purification. Let this experience work for you.

PURIFIERS
FILTERS
RECLAIMERS
CONDITIONERS

A complete range of sizes and systems for oil purification.

Filter

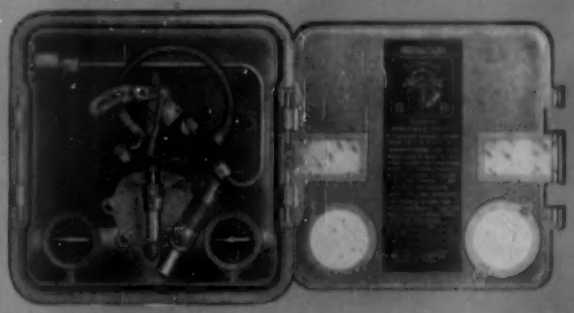
★ *WRITE FOR* **FREE** *LITERATURE NO OBLIGATION ON YOUR PART*

THE HILLIARD CORPORATION
23 W. FOURTH ST.
ELMIRA, N. Y.

IN CANADA — UPTON-BRADEEN-JAMES, Ltd.
890 Yonge St., Toronto, 3464 Park Ave., Montreal

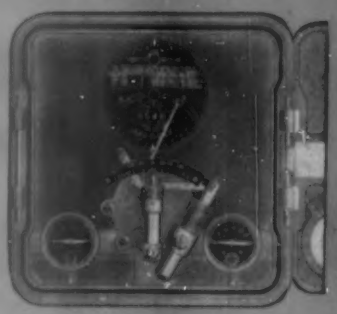
BS&B Announces:

. . . An Even Better Pressure Controller — Climax Type 1440



The Climax Type 1440 Pressure Controller (non-recording) is designed to handle both positive and negative pressures, from high vacuum to pressures of up to 10,000 lbs. Bourdon Tube actuated — with all tubes, bellows assemblies, feed orifices and bleed nozzles calibrated — the Type 1440 is an instrument of utmost accuracy. Proportional band and On-Off or Maximum-Minimum snap action adjustment is easily made without additional parts. Snap action may be adjusted to pressures up to 75% of the limits of the Bourdon Tube rating.

. . . An Even Better Liquid Level Controller Pilot . . . Climax Type 1450



The type 1450 Liquid Level Controller Pilot was developed for use and mounting on any Climax Type 888, 888-LF, 887 and 889 displacement liquid level controllers where a torsion tube transmits float movements to reflect changes in liquid level or a change in gravity of the controlled liquid. Its interchangeability of parts with those of the Type 1440 Pressure Controller is an advantage which reduces stocking parts.

Type 1450 features a very wide "throttling" range calibrated from 0% to 100%. A specific gravity index is provided and offers a method of compensating for various gravities of liquids, or for inter-face services, where the "throttling" range is kept exact in its relationship to the specific gravity setting.

A novel feature of the Type 1450 is its adjustability, without use of special parts, for "snap" or "on-off" action. This is useful when it becomes desirable for the diaphragm control valve to fully open or close when liquid level height reaches a desired "high" setting, and to react in an opposite manner at a desired "low" setting. The amount of liquid level change from open to shut positions of the control valve may be varied up to 75% of displacement element length.

Improved Features of Types 1440 and 1450:

1. Weatherproof case of die-cast aluminum designed for universal mounting.
2. Compact size — 8" x 8" x 4".
3. Door hinges to left or right, as desired.
4. Straight line piping.
5. Proportional bellows, calibrated, spring opposed.
6. Micro-adjusted set-point, graduated.
7. Molded diaphragms in power unit.
8. Easy parts replacement or assembly.
9. Feed orifice cleaner.
10. Snap action available over 10% to 75% of tube range without additional parts. (Applies to Type 1440 only.)
11. Pilot action reversible by moving a single link, without tools.
12. Elimination of superfluous linkages, resulting in easier adjustability and greater sensitivity.

Types 1440 and 1450 Have Been Developed and Thoroughly Field Tested for More Than Two Years!

Types 1440 and 1450 are but a small part of the complete Climax line—designed, engineered and precision manufactured by BS&B to meet your most exacting requirements. Send for your free copy of the complete Climax catalog!

For Better Process Controls . . . Always Specify BS&B Climax!

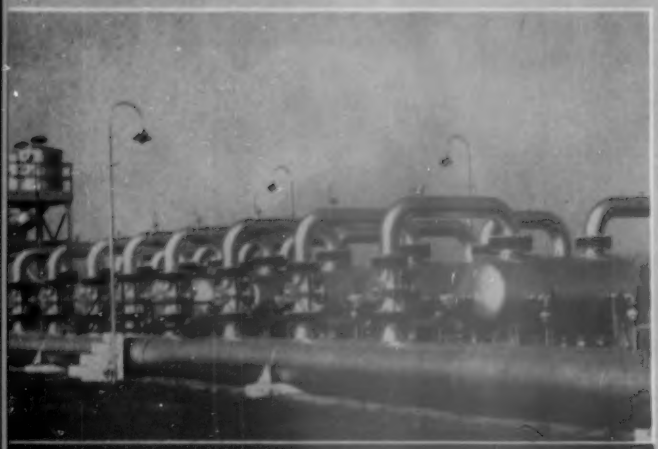
EFFICIENCY — OVER 60 YEARS — BS&B — RELIABILITY

BLACK, SIVALLS & BRYSON, INC.

Climax Controls Division, Dept. 4-A5

7500 East 12th Street — Kansas City 26, Missouri

King Gas Separator...Scrubber



Typical installation of KING GAS SEPARATOR-SCRUBBERS used to replace conventional type scrubbers throughout Tennessee Gas Transmission Company's System.

Typical original installation of KING GAS SEPARATOR-SCRUBBERS as used at new stations by Tennessee Gas Transmission Co.

A revolutionary departure from conventional design, the King scrubber is both a liquid separator and an oil-bath cleaner, combined into a single vessel. It is designed to give *greater efficiency than any other oil-bath scrubber* in separating liquid from wet-quality gas, and dirt from dry-quality gas, without necessitating any change in scrubber set-up. Large capacity of each unit reduces the size and number of scrubbers required per million feet of gas to be handled. This reduces the capital investment required, not only in total cost of scrubbers but also in expense of foundations, fittings and piping.

GREATER GAS CAPACITY

LESS OIL LOSS

REDUCED PRESSURE DROP

LOWER INSTALLATION COST

King scrubbers are in use today by many gas pipeline companies, including several of the largest in the country. *Every one of these companies, after using King scrubbers, has placed an order for additional units.*

We shall be happy to give you complete information on the King separator-scrubber.

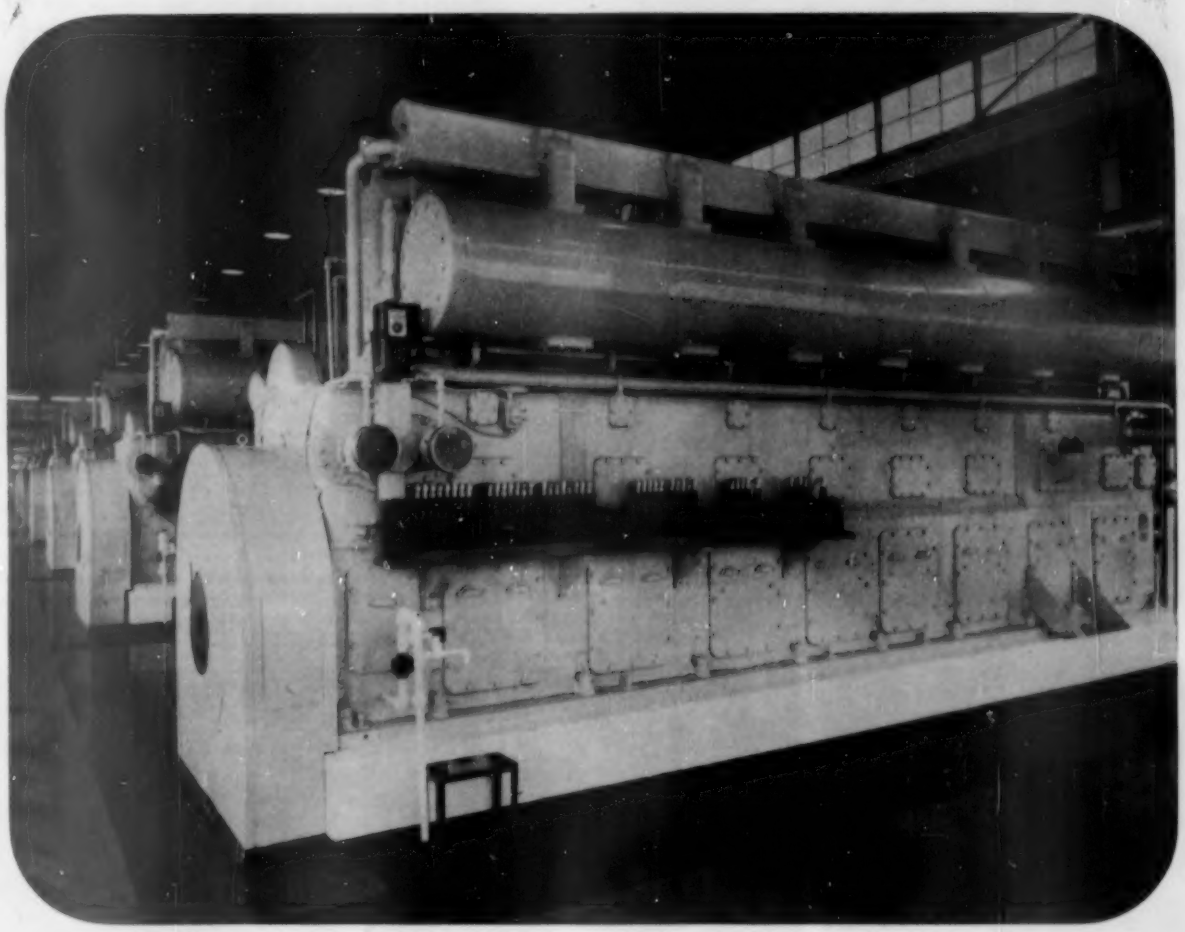
King

KING TOOL COMPANY, LTD.

LONGVIEW, TEXAS

Marquette
HYDRAULIC GOVERNORS

...regulate the speed of 1600 h.p. Clark Bros. Co. compressors in one of the many main line booster stations of TENNESSEE GAS TRANSMISSION CO.



The Marquette
METAL PRODUCTS CO.
CLEVELAND 10, OHIO
SUBSIDIARY OF CURTISS-WRIGHT CORPORATION

Also Manufacturers of:
ROLLER BEARING TEXTILE SPINDLES
WINDSHIELD WIPERS FOR AIRCRAFT
FUEL OIL PUMPS AND INJECTORS
PRECISION PARTS AND ASSEMBLIES
ROTARY HIGH PRESSURE OIL FIELD PUMPING MACHINERY

AT FOSTORIA, TEXAS. This compressor station of Tennessee Gas Transmission Company handles more than a billion cubic feet of gas per day. Uniformity of TUBE-TURN Welding Fittings simplifies construction of piping such as this header.

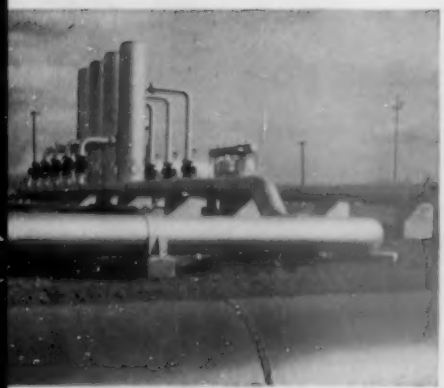
tt
TUBE-TURN
TRADE MARKS

All along the Tennessee Line...

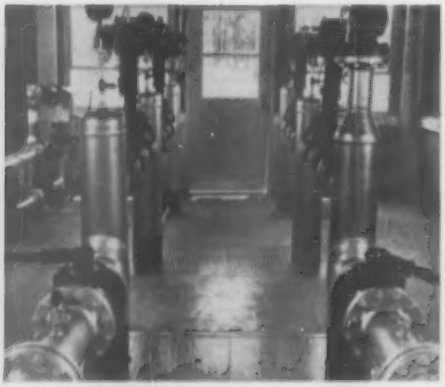
TUBE-TURN
WELDING FITTINGS AND FLANGES

simplify construction
...assure reliable service

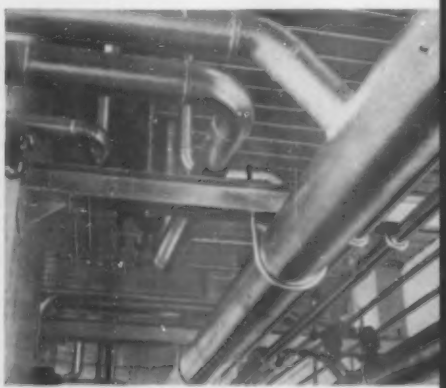
ALL TYPES OF FLANGES . . . There are TUBE-TURN Flanges to match the pressure pipe size and service all along the Tennessee line. This welder at the Mercer Station is fabricating a 12-inch high pressure header cross-over with a TUBE-TURN Slip-on Flange.



AT MERCER, PA. At this compressor station of Tennessee Gas Transmission Company gas pressure is boosted with a total of 6600 hp. Here too extensive use of TUBE-TURN Welding Fittings helped speed construction and assure dependable piping. Shown here are 26-inch intake and discharge lines.



ALL TYPES OF FITTINGS. This metering house at Fostoria includes a variety of TUBE-TURN welding caps, reducers, saddles, elbows, tees and flanges. Tube Turns' nation-wide distributor network provides prompt delivery of these products.



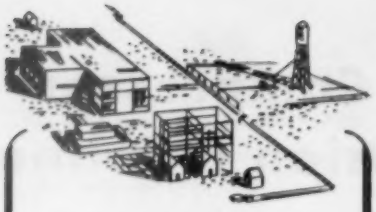
BIG OR SMALL. You'll find TUBE-TURN Welding Fittings used on Tennessee's cross-country lines . . . as well as for smaller lines such as this group at Fostoria.

TUBE TURNS LOUISVILLE 1, KENTUCKY

A Division of National Cylinder Gas Company

"tt" and "TUBE-TURN" Reg. U. S. Pat. Off.

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Cleveland • Chicago • Denver • Los Angeles
San Francisco • Seattle • Atlanta • Tulsa • Houston • Dallas • Midland, Texas



trustworthy performance

• is yours, when backed by the integrity of construction specialists.

STATION CONSTRUCTION CO.

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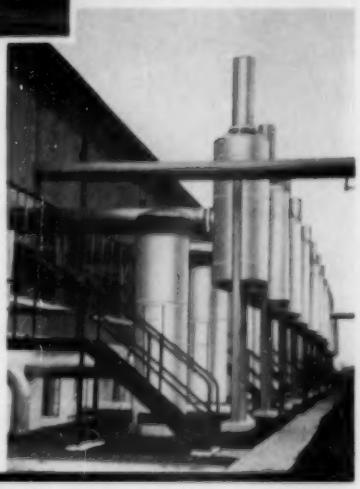
Below: Exhaust snubbers and combination air filter snubbers engineered and built for four 1,600 h.p. and eight 2,000 h.p. gas engines at Station #1, Agua Dulce, Texas.



Proper silencing is one of the keynotes of efficiency. That is the reason Tennessee Gas Transmission Company, operator of one of the major trunk line systems in the country, consulted Burgess-Manning Sound Engineers on their silencing requirements. Over one hundred snubbers were engineered and constructed by Burgess-Manning to eliminate the intake and exhaust noises at compressor stations along the Tennessee line.

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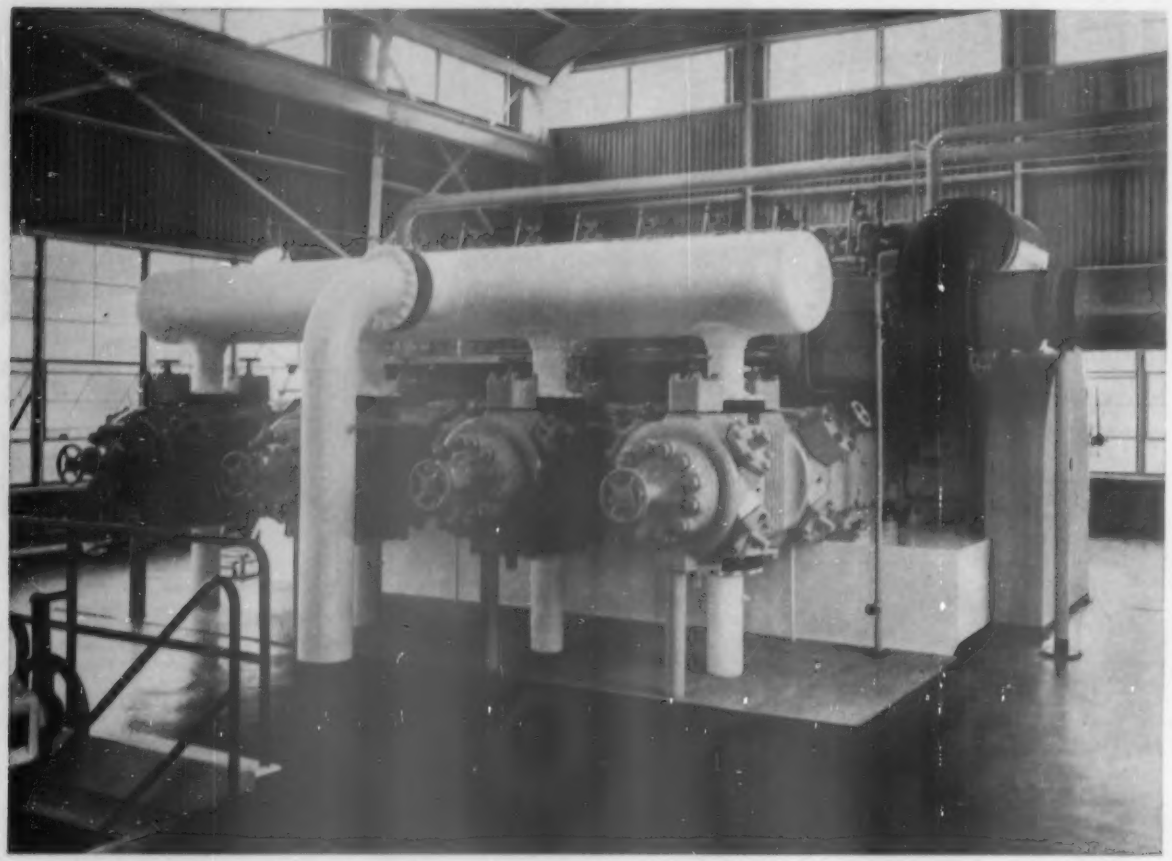
New Clark Turbocharged Compressor on Tennessee Gas Transmission Pipeline shows improved operating economy



The simple, clean-cut design of both turbocharger and compressor is shown in this view of Tennessee Gas Transmission Co.'s TRA-8 installation. Both the new Turbocharger and Gas-Engine-Driven Compressor were designed and built by Clark as matching units.

Substantial savings in fuel, cooling water, foundation and installation realized

IT'S only natural that the Tennessee Gas Transmission Company, one of the largest capacity major trunk line systems in the country and also one of the most progressive in the field, should be among the first to install a new Clark Turbocharged Compressor.

TGT'S 99TH CLARK UNIT

The new unit, a Model TRA-8, was placed alongside 26 Clark "Big Angles" in TGT's Middleton, Tennessee compressor station, making it the 99th Clark Compressor in the Company's vast system.

FUEL CONSUMPTION LOWERED

That was back in February. What has happened since is important news for the whole industry. From the day the unit was first placed on stream at its rated 1320 BHP load, it has met or exceeded all expectations. Fuel consumption is considerably less than on units not turbocharged, checks by engineers showed. There have been no forced mechanical shutdowns. Only the usual minor adjustments which occur on any new piece of equipment were made.

RECORD ANTICIPATED BY CLARK

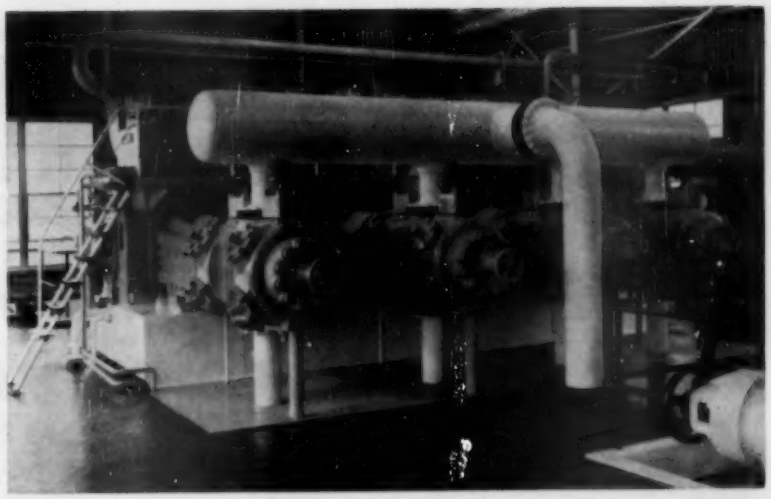
Of course, performance records such as this were not unexpected. According to Clark engineers, the TRA and TLA were specifically *designed* from the ground up as turbocharged, 2-cycle, gas-engine-driven compressors with all components perfectly matched. They were *designed* to burn 10 to 12½% less fuel, to require 40% less cooling water and to deliver considerably more power in 25 to 30% less floorspace than comparable non-turbocharged compressors.

BIG BOON TO OPERATING ECONOMY

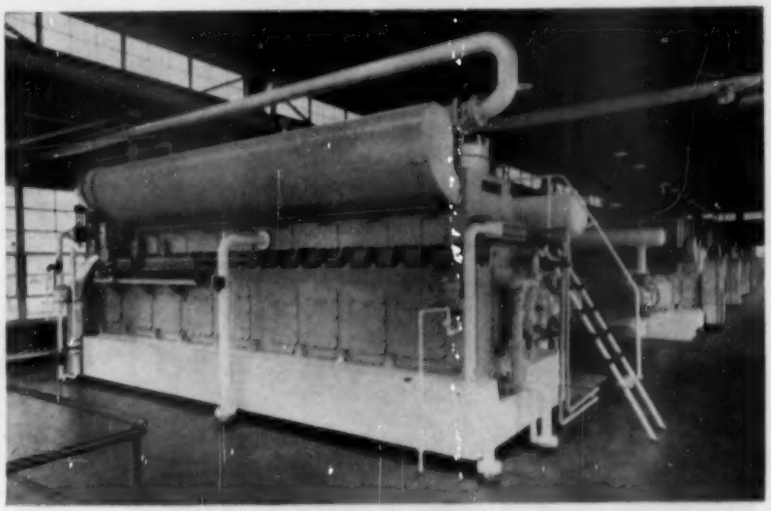
With operating economies more essential today than at any time in history, the new TRA and TLA have already proved to be one of the most practical means of decreasing compressor operating and installation costs per bhp, according to Clark engineers.

NEW LITERATURE PUBLISHED

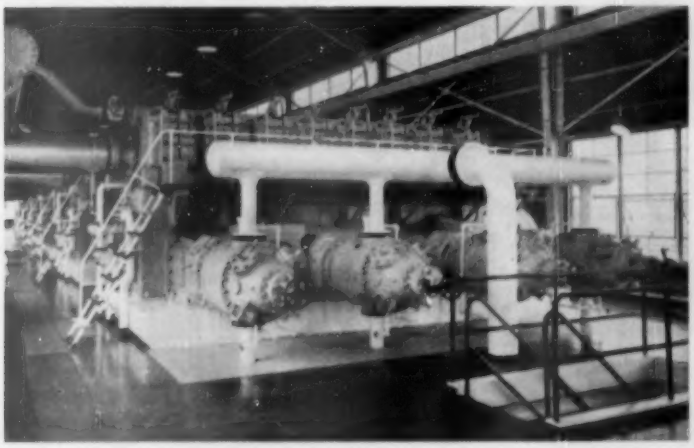
Clark Turbocharged Compressors are built in the 825-3300 BHP range. Bulletins 130 and 134, describing Models TRA and TLA respectively, are available by writing Clark Bros. Co., Division of Dresser Operations, Inc., Olean, New York.



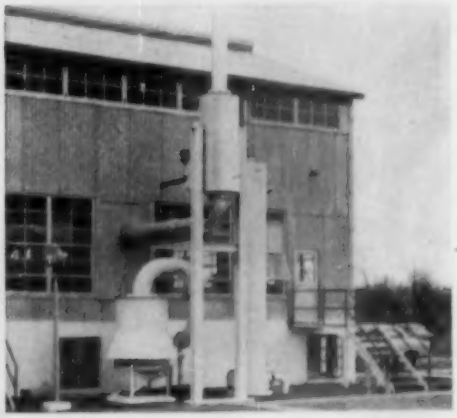
Tennessee Gas Transmission Co.'s TRA-8 is equipped with four Clark air cooled pipeline type compressor cylinders.



Minimum of piping required for Clark Turbocharged Compressor is exhibited in this view of the TRA-8, from the exhaust manifold side, at Tennessee Gas Transmission Co.'s Middleton station.



The Clark TRA-8 along with 7 Clark HBA-8 Compressors is housed in this Tennessee Gas Transmission Co. building. A total of 26 Clark "Big Angles" are housed in three buildings at the Middleton, Tenn. station.



Exterior of compressor building shows the simplicity of Clark Turbocharged Compressor installation. Notice that only one air inlet pipe, one exhaust pipe, one muffler and one air cleaner are required.

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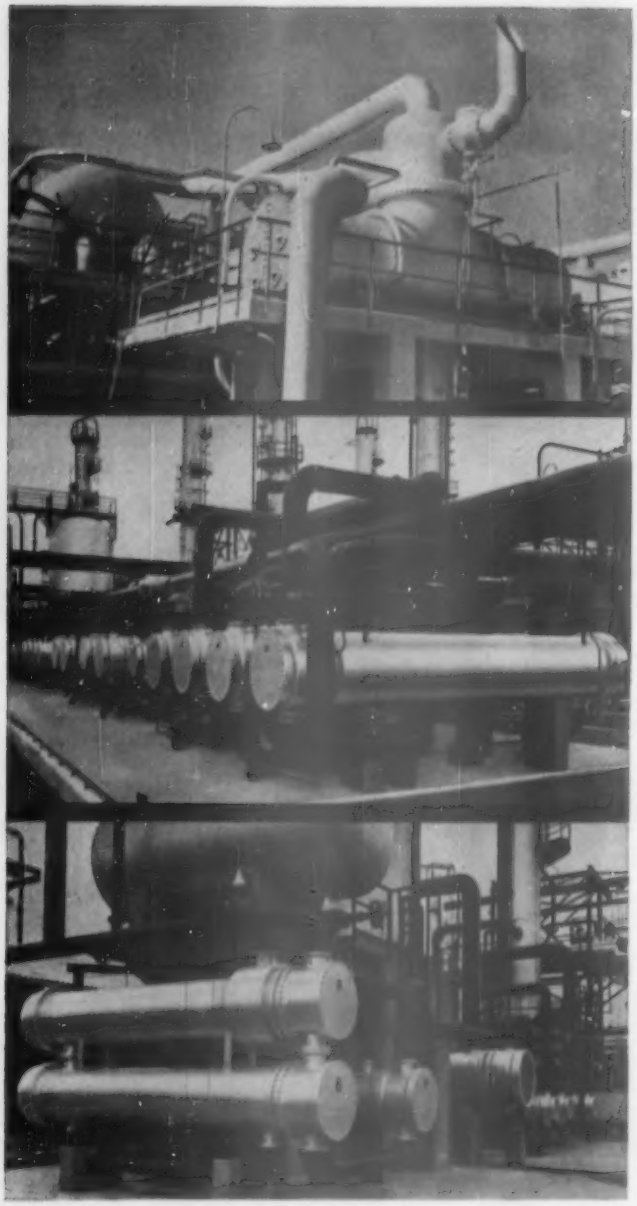

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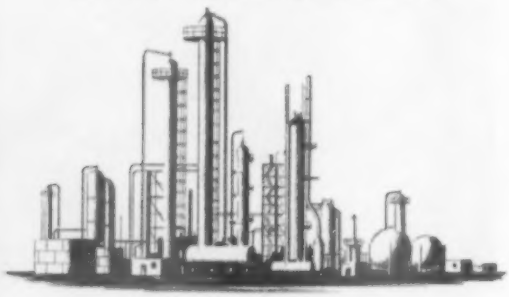

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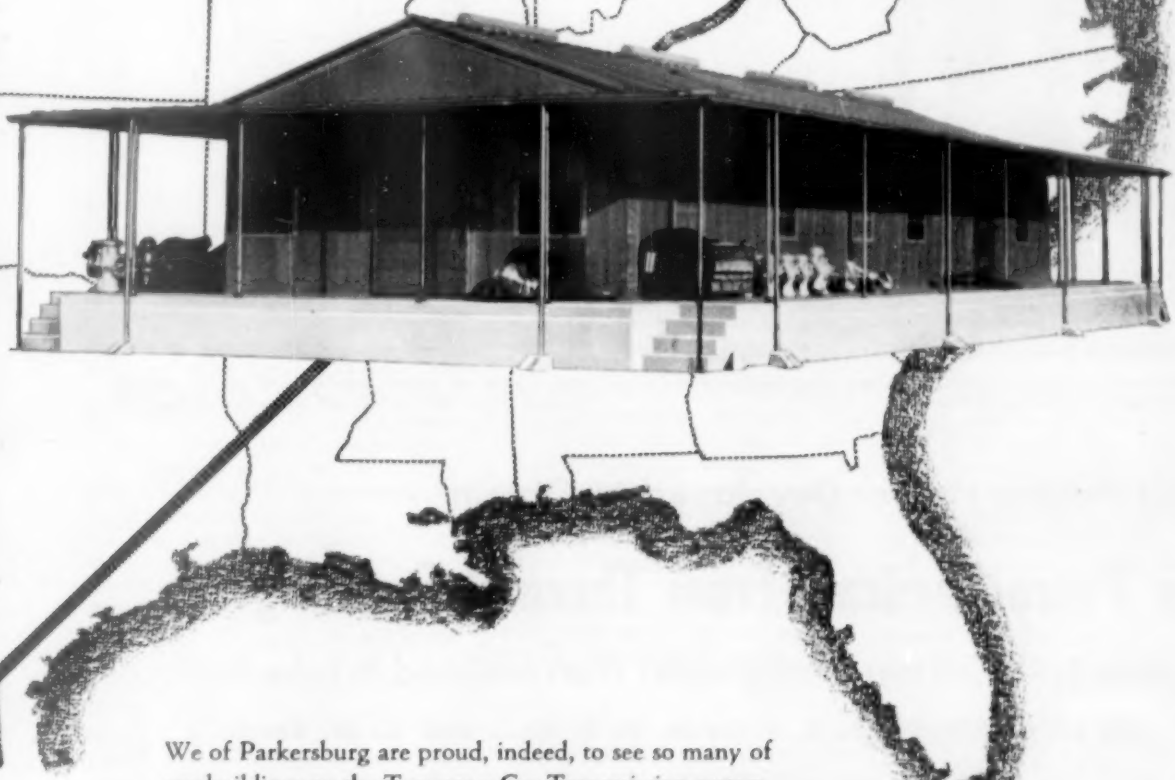

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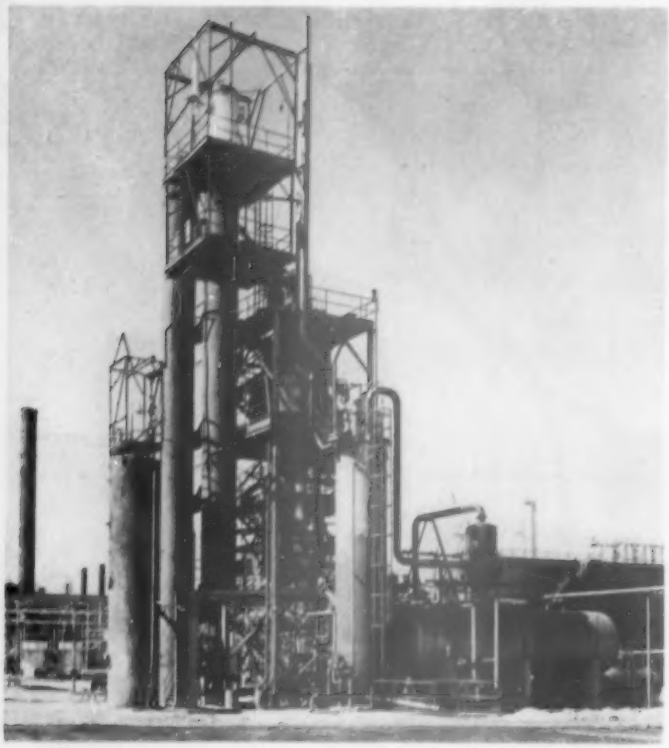

Fig. 1—Pebble heater consists of two refractory-lined vessels positioned one above the other. Pebbles are heated in top vessel.

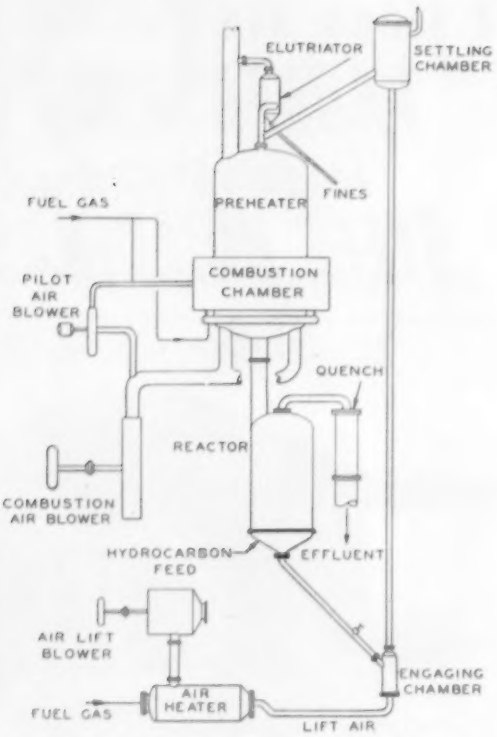

Fig. 2—Bed of pebbles extends from top of preheater, through throat and reactor, and down to engaging chamber of pneumatic lift.

Phillip's Pebble Heater Developed to Obtain

More Petrochemicals From Thermal Cracking

Ethylene yield 50 per cent greater than realized in tube furnaces

by M. O. Kilpatrick, L. E. Dean, D. S. Hall, and K. W. Seed

A NEW process tool, the "pebble heater," has been developed by Phillips Petroleum Co. for light hydrocarbon cracking and high temperature superheating. This unit was developed to obtain the higher yields of ethylene and acetylene which result from higher temperatures, shorter contact times, and lower pressures than normally realized in tube cracking furnaces.

While cracking n-butane, the yield of ethylene is 50 per cent greater than has been realized in tube furnaces. Cracking an ethane-rich feed gives a yield of ethylene plus acetylene 25 per cent greater than tube furnaces. This yield is obtained at 91 per cent ethane conversion which is generally considered to be unattainable in tube furnaces. Superheating temperatures as high as 2,500° F. are practical.

Authors with Phillips Petroleum Co., Bartlesville, Okla. Presented at the Western Petroleum Refiners Association annual meeting, San Antonio, March 30, 1954.

Investment for a pebble heater will be slightly more than for a tube furnace for hydrocarbon cracking. However, economic evaluations of the cracking and recovery steps as a whole should show considerable advantage for the pebble heater.

The pebble heater has uses other than hydrocarbon cracking with which the tube furnace cannot compete. These uses include the heating of corrosive materials as well as the superheating of steam, air, or inert gases to very high temperatures. In these fields of operation, the investment costs for a pebble heater would be less than for hydrocarbon service.

As shown in Fig. 1, the pebble heater proper consists of two refractory-lined vessels positioned one above the other and connected by a refractory-lined 7-in.-diameter duct or throat. In the top vessel, called the preheater, pebbles are heated by direct contact with high-temperature combustion gases. In the lower vessel, called the reactor, the hot pebbles from the preheater are contacted in countercurrent flow with the material to be superheated or cracked.

The remainder of the unit consists of the pneumatic pebble lift, effluent quench vessels, combustion air blower and auxiliary equipment. Small refractory pebbles are used as the heat-transfer medium. These pebbles are approximately ⅜-in. spheres and were developed specifically for this use. The unit now being operated by Phillips at Borger, Tex., is a 30-million-B.t.u. per hour heater which for several years has been operated experimentally to perfect me-

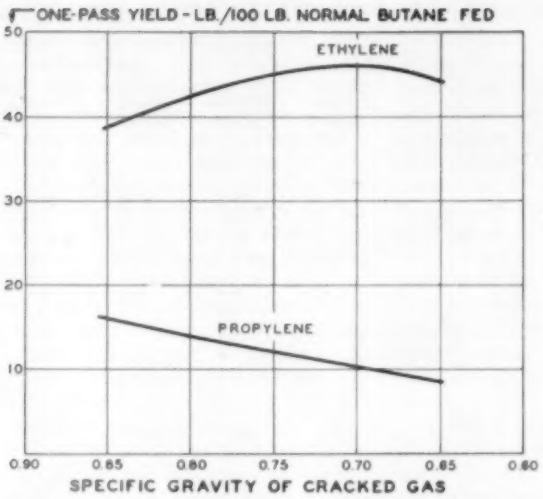

Fig. 3—Yields of products from cracking n-butane in pebble heater.

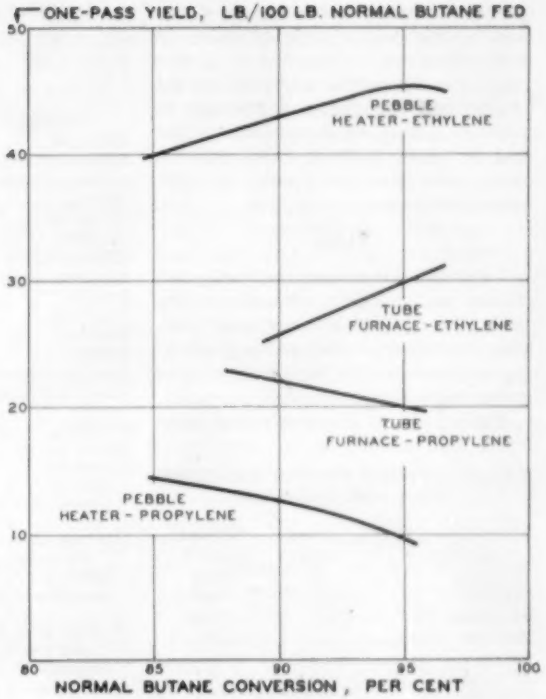

Fig. 4—Products yields from cracking n-butane.

chanical and process design and to evaluate various feed stocks.

Fig. 2 is a schematic drawing of the pebble heater and shows more clearly the component parts of the unit. A bed of contiguous pebbles extends from the top of the preheater, through the throat and the reactor, and down to the engaging chamber of the pneumatic lift. The entire bed of pebbles moves slowly downward through the preheater and reactor at a rate set by a flow-control device in the engaging chamber. In the engaging chamber the pebbles fall into a stream of heated air and are elevated through the lift line to the settling chamber. Here the pebbles disengage from the lift gases and return by gravity to the top of the pebble bed in the preheater.

As the pebble bed moves downward through the preheater, the pebbles are heated by an upward flow of hot combustion gases which are generated under pressure in the circumferential combustion chamber. In the reactor, the downward moving hot pebbles are contacted directly by the upward flowing gaseous charge for heating or cracking. To withstand the cyclic heating and cooling and the mechanical handling, the pebbles must be resistant to thermal and mechanical shock and to abrasion, as well as being capable of withstanding high temperatures.

Pebble circulation . . . After several years of development work and close cooperation with pebble manufacturers, very satisfactory pebbles have been developed for pebble-heater use. Continuous elutritation is provided to prevent a buildup in the circulating pebble bed of the small quantity of pebble fines and chips produced. This is accomplished by a damper located in the stack which forces a stream of flue gas from the preheater through a vertical portion of the pebble transfer duct between the settling chamber and the preheater. The fines thus removed from the main pebble stream are separated from the gases in a small cyclone and returned to the ground.

As originally constructed, this unit had a bucket elevator to return the pebbles from the reactor outlet to the preheater top; however, because of excessive maintenance and high pebble breakage, the elevator was replaced with the pneumatic lift. This lift has operated very satisfactory with negligible maintenance and low pebble breakage.

The combustion chamber is operated at pressures up to 5 psig., and an air blower is provided to raise the combustion air to this pressure. In the combustion chamber, natural gas is burned in multiple burners to provide a uniform combustion gas temperature completely around the preheater pebble bed.

Unit feed . . . Hydrocarbon feed is admitted to the lower portion of the reactor through a distributor designed to provide uniform pebble flow and uniform feed distribution. Cracking depth is controlled by means of reactor effluent temperature or gravity. The cracked gases pass out the top of the reactor into a primary quench vessel where the temperature is quickly reduced to about 400° to 700° F. by direct water spray.

In a second vertical quench tank the effluent temperature is lowered to about 125° F. The gases then pass through an oil spray, a scrubber, and a mist extractor to remove the small quantity of tars and oils which do not drop out in the water quench system.

A small pressure differential is maintained between the bottom of the preheater and the top of the reactor to prevent the undesirable mixing of combustion products and cracked hydrocarbon gases. In addition, steam is in-

TABLE 1—TYPICAL PEBBLE HEATER OPERATING DATA FOR N-BUTANE CRACKING

Pressure, psig.:	
Combustion chamber	3.4
Reactor feed inlet	5.2
Reactor outlet	3.3
Temperatures, °F.:	
Combustion chamber	2,300
Reactor effluent	1,625
Pebbles to reactor	1,730
Pebbles from reactor	950
Air to air lift	950
Quantities:	
Hydrocarbon feed (95 per cent n-butane), gal. per day	34,600
Combustion air, std. cu. ft. per hour	560,000
Combustion fuel (1,000 B.t.u.), std. cu. ft. per hour	30,000
Cooling water, M.M.B.t.u. per hour	19
Electric power, kw.-hr. per day	530
Steam, 250 psig., M. lb. per day	440
Instrument air, 60 psig.; cu. ft. per minute	25
Pebble makeup, lb. per day	150

jected into the throat between the chambers to maintain a flow of steam in both directions. A steam seal is also utilized in the pebble duct between the reactor and the engaging chamber to prevent mixing of hydrocarbon feed and lift gases. Both of these seals are easily maintained and present no operational problems.

Yields

Table 1 lists typical operating conditions for cracking n-butane in the pebble heater. The low operating pressure, short contact time, and high cracking temperatures are significant factors in the high yields obtained.

Table 2 shows the feed and effluent analyses for a n-butane conversion of 91 per cent. The ethylene and propylene contents of the reactor effluent were 37.3 and 6.7 mole per cent, respectively. One-pass yields (pounds per hundred pounds n-butane feed) were 44.1 lb. of ethylene and 12.5 lb. of propylene. Under the conditions cited in Tables 1 and 2 for n-butane cracking, the 30-M.M.B.t.u. Borger pebble heater will produce 74,000 lb. per day of ethylene and 21,000 lb. per day of propylene.

TABLE 2—PEBBLE-HEATER CRACKING DATA FOR N-BUTANE

Component—	Feed, mole %	Effluent, mole %
Hydrogen	....	16.6
Methane	....	30.5
Acetylene	....	1.2
Ethylene	....	37.3
Ethane	....	2.0
Propylene	....	6.7
Propane	0.3	0.1
Butadiene	....	0.6
Butenes	....	0.5
Isobutane	4.7	0.3
n-Butane	94.6	3.5
Other	0.4	0.7
Total	100.0	100.0
n-Butane conversion, per cent	....	91.0

	One-pass yield*	Ultimate yield†
Ethylene	44.1	48.4
Propylene	12.5	13.3

*Pounds per 100 lb. n-butane fed. †Pounds per 100 lb. n-butane converted.

TABLE 3—PEBBLE-HEATER DATA FROM ETHANE-PROPANE MIXTURES

	Case 1—For maximum ethylene		Case 2—For ethylene plus acetylene	
Component—	Feed, mole %	Effluent, mole %	Feed, mole %	Effluent, mole %
Hydrogen	....	34.9	....	43.8
Carbon monoxide	....	1.0	....	1.2
Carbon dioxide	0.1	0.3	0.1	0.3
Methane	34.9	29.8	32.2	25.8
Acetylene	....	2.3	....	5.4
Ethylene	....	25.3	....	20.1
Ethane	55.2	3.9	63.1	1.1
Propylene	....	0.5	....	0.3
Propane	9.8	0.1	4.6	0.1
Butadiene	....	0.5	....	0.4
Benzene	....	0.7	....	0.8
Toluene	....	0.2	....	0.2
Cyclopentadiene	....	0.1	....	0.1
Heavy acetylenes	....	0.4	....	0.4
Total	100.0	100.0	100.0	100.0
Conversion:				
Ethane	....	88.3	....	96.8
Ethane plus propane	....	90.0	....	96.8
One-pass yield (moles per 100 moles ethane plus propane fed):				
Ethylene	....	64.3	....	53.4
Acetylene	....	5.8	....	14.5
Ultimate yield (moles per 100 moles ethane plus propane converted):				
Ethylene	....	71.6	....	55.2
Acetylene	....	6.5	....	15.0

Fig. 3 is a plot of ethylene and propylene one-pass yields from n-butane cracking. This plot shows that the peak ethylene yield occurs at about 0.7 specific gravity (96 per cent conversion). However, an increased quantity of oils and tars is also produced at this cracking severity, and operation is improved by controlling cracking depth to give a cracked-gas specific gravity in the range of 0.75 to 0.78 (94 to 92 per cent conversion). This is accomplished without appreciable loss in one-pass ethylene yields and with some gain in cracking efficiency or ultimate yield.

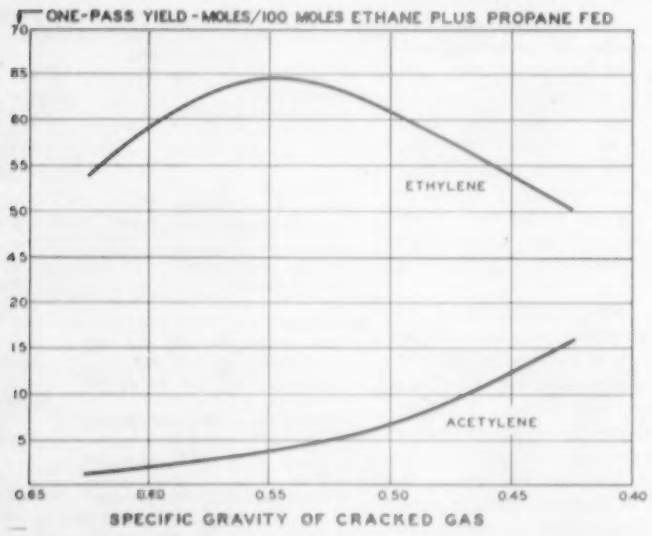

Fig. 5—Yields of products from cracking an ethane-propane mixture in pebble heater.

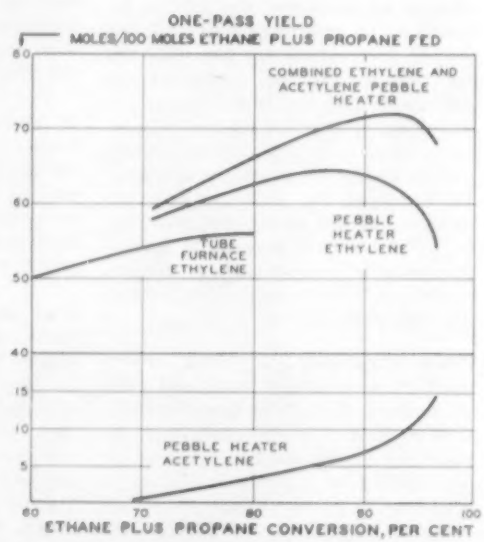

Fig. 6—Yields of products from tube furnace and pebble heater cracking of an ethane-propane mixture.

Yield comparisons . . . Fig. 4 shows a comparison of pebble heater and tube furnace one-pass yields of ethylene and propylene from n-butane cracking. At 92 per cent n-butane conversion ethylene one-pass yield from pebble heater is 63 per cent greater than the tube-furnace ethylene yield. At this same conversion the propylene yield is 46 per cent less from the pebble heater than from the tube furnace. The combined ethylene plus propylene yield is 15 per cent greater for the pebble heater than for the tube furnace. It is significant to note that the pebble heater at 92 per cent conversion yields 50 per cent more ethylene than does the tube furnace at 96 per cent conversion.

Table 3, listing the feed and effluent analyses for two cases, shows the effect of ethane conversion level on product distribution. Case 1 data are for maximum ethylene yield which occurs near 90 per cent conversion of ethane plus propane. Case 2 data show that an increase in conversion to 96.8 per cent lowers the ethylene yield and increases the yield of acetylene.

Although the ethylene one-pass yield is reduced from 64.3 to 53.4 moles per 100 moles of ethane plus propane in the feed while the acetylene yield is increased from 5.8 to 14.5, there is only a small decrease in combined yield of ethylene plus acetylene. The 30-M.M.B.t.u. unit at Borger will produce, in the first case, 56,500 lb. per day of ethylene and 4,600 lb. per day of acetylene. In the second case the production is 46,800 lb. of ethylene and 11,800 lb. per day of acetylene.

Fig. 5 is a plot of ethylene and acetylene one-pass yields from cracking an ethane-propane mixture. After passing its peak, the ethylene yield decreases and the acetylene yield increases. The sharpness of the peak is caused in part by the relatively large amount of methane in the feed which tends to hold the effluent gravity at 0.55. If methane were not present the curve would be considerably flattened.

Ethane-propane cracking . . . Fig. 6 shows a comparison of pebble heater and tube furnace one-pass yields of ethylene and acetylene from ethane-propane cracking. Both units were cracking essentially the same feed. Maximum conversion of ethane plus propane attained in the tube furnace was held to 80 per cent because of metal-temperature limitations. This corresponded to an ethane conversion of 75 per cent. At this conversion ethylene one-pass yield was 56 moles per 100 moles of ethane plus propane in the feed, while the acetylene yield was essentially zero.

The temperature limitations imposed upon the tube furnace do not apply to the pebble heater. For this reason the pebble heater can obtain ethane conversions as high as 97 per cent. At this high conversion a considerable amount of acetylene is produced. At the maximum ethylene yield point (88 per cent conversion) cracking an ethane-propane mixture, the pebble heater produces 15 per cent more ethylene than does the tube furnace. However, a better comparison would include the acetylene. Such a comparison at the 88 per cent conversion level shows that the pebble heater produces 25 per cent more ethylene plus acetylene than the tube furnace.

A still greater amount of ethylene plus acetylene is produced by the pebble heater at the peak of its combined yield curve at 93 per cent ethane plus propane conversion. It is of interest to note that even at 97 per cent conversion the cracking efficiency or ultimate yield of the pebble heater is equal to that of the tube furnace cracking at 75 per cent ethane conversion (80 per cent ethane plus propane conversion). At high conversion levels, ethylene recovery and purification equipment is simpler and smaller and recycle ethane is considerably reduced or entirely eliminated.

Although the design of the pebble heater is unique, it employs conventional equipment and is easily operated. One operator can readily handle two or three such units.

One of the major problems in pebble heater development was the reduction of carbon deposition in the reactor. Careful design has alleviated this problem but periodic burnouts of short duration are occasionally required. As more operating and design experience is gained, it is expected that burnout frequency can be further reduced or entirely eliminated.

Early operation of the pebble heater was severely handicapped by high pebble consumption caused by both abrasion and breakage. This is no longer a problem. At the present time pebble consumption for a 30-M.M.B.t.u. unit in hydrocarbon service is about 150 lb. per day.

Mechanical maintenance costs are low. Although the unit uses blowers and turbines, modern equipment of this type requires little attention. Refractory life is good. The last turnaround followed nearly 1 year of operation, at which time the refractories were in excellent condition and appeared to have several years of life remaining.

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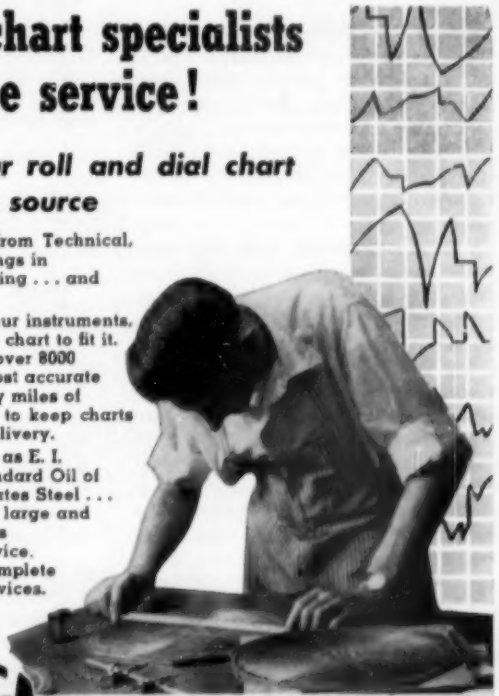

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PROGRESS REPORT:

More on the Fluid Coking Process

by H. Z. Martin,* F. T. Barr,* and R. W. Krebs†

FLUID coking is a new coking process which has been developed at the Esso Laboratories at Linden, N. J., and at Baton Rouge, La. The process is an adaptation of the fluidized-solids technique to the coking of crude residua and similar low-grade oils.

Advantages include:

- More gas oil and gasoline are produced.
- Coke yield from a given charge is reduced.
- Product coke is fine, uniform, and easily handled. Very little hydrogen and volatile matter are found in the product.
- The process is continuous.

Original article on the process was presented before the A.P.I. national meeting in Chicago in November 1953. The article appeared in The Journal in its November 16, 1953, issue. This present article constitues a progress report on work done on the process since that time.

Some yield information on the fluid coking process is obtained from operation of a 100-bbl. per day pilot plant; however most data on yields have been obtained from several different types of small units. These are batch-type fluid-bed units in which pitch is fed to the fluid coking bed at the rate of about .1-bbl. per day.

A large amount of work has been carried out on small units of this general type to give yield and product-quality information from a variety of feeds and operating conditions. Comparison of the results from small units with those from the 100-bbl. per day pilot plant shows that the small units give yields which correlate well with those from the larger unit. Accordingly, yield predictions suitable for studying commercial application of the process can be based on the small-unit data. This saves considerable time and cost, especially when a variety of potential feeds is to be studied.

Over 25 different feed stocks have been run in the testing units. These have comprised short, vacuum residua, and longer atmospheric residua. Gravities have ranged from as low as –2.5° A.P.I. to 23.5°. Feeds with Conradson carbons from as low as 1.7 per cent to as high as 36.6 per cent have been run. Most of the feeds have been virgin residua, but some work on visbreaker tars has been carried out.

The laboratory work has, in general, been first-pass, once-through operation rather than recycle to ultimate yield, as is normally contemplated for commercial application of fluid coking. Depending on the feed stock, the first pass gives 70-95 per cent conversion of vacuum pitch to lower-boiling products. Operating conditions are also important in establishing first-pass conversion. To determine what recycle yields will be, a study of successive pass coking has been made. Owing to the relatively high first-pass conversion, the results for recycling operation to ultimate yield can be estimated with satisfactory accuracy. A new 1-bbl. per day recycling unit is to be available to confirm recycle yields.

Yield and quality of coker products from once-through operations of the 100-bbl. per day pilot plant were given in the earlier paper.[1] For commercial operation ultimate yield of gas oil and lighter products will normally be desired.

Yields on Vacuum Residua

Comparative fluid coking results for ultimate yield operation are shown in Table 1. Here, operations on pitches covering a fairly wide range of quality are outlined. The feeds chosen as examples are vacuum pitches from a South Louisiana crude mixture, and Hawkins and Elk Basin crudes. The feed from South Louisiana crudes, while exemplifying a good-quality pitch, is not the best quality available so far as fluid coking is concerned. A number of other crudes, especially from Mid-Continent fields, can be expected to provide feeds to fluid coking which will give even more attractive yields of distillate products.

On the other hand, the Hawkins and Elk Basin figures are examples of fluid coking results on rather poor pitches. A great variety of residua lie between these limits insofar as coking quality is concerned.

It will be noted that the examples shown cover a gravity range from 2° to over 13° A.P.I. and Conradson carbon from 14-30 per cent. The hydrogen-carbon atomic ratios vary from 1.35 to 1.57, and sulfurs from less than 1 to over 4 per cent. All of these pitches are from deep vacuum distillation, have pour points over 120° F., and are, under normal conditions, solids.

The variation in Conradson carbon in the feeds is reflected in the coke yields. Consequently, from materials-balance considerations, yields of distillate products vary inversely with Con-

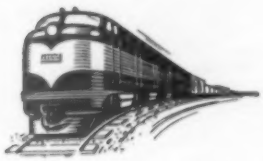
TABLE 1—FLUID COKING OF VACUUM RESIDUA ULTIMATE YIELDS

Crude source of feed—	South Louisiana mixture	Hawkins	Elk Basin
Feed inspections:			
Gravity, °A.P.I.	13.2	4.2	2
Conradson carbon, weight per cent	14	24.5	30
Pour, °F.	120+	120+	120+
S, weight per cent	0.9	4.3	3.8
C, weight per cent	87.3	85.1	86.4
H, weight per cent	11.5	10.1	9.8
H-C atomic ratio	1.57	1.41	1.35
Ultimate yields on coker feed:			
C_3, weight per cent	8	9.5	10
C_4-430° F. V.T. naphtha, volume per cent	24	23	22
430°-1,015° F. V.T. gas oil, volume per cent	61	52	45
Coke, weight per cent (gross)	16	27.5	34
Product quality:			
Naphtha res. octane number, clear	77	77	77
Sulfur, weight per cent	0.1	0.7	0.3
Gas-oil gravity, °A.P.I.	21	17	17
Sulfur, weight per cent	0.6	3.7	2.8

*Standard Oil Development Co. †Esso Standard Oil Co. This article is condensed from one presented by the authors at 1954 W.P.R.A. meeting in San Antonio.

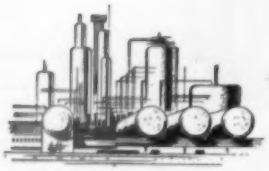
Why Alloy Steels?

Carbon steels are better today than ever before. A major producer of both carbon and alloy steels, Republic is aware of this fact. Even so, there are limits to the application of carbon steels. Machine design may restrict the size of a part. High strength may be an essential combination with light weight. Sometimes surface hardness and ductility must be held within the limits. Such are the applications in which *only* alloy steels can perform definite tasks with certainty of results at lower ultimate cost.



Take large sections—where hardness must be carried deep into the steel. Heavy crankshafts, connecting rods, piston rods, large gear and axles are examples. Here alloy steels *are necessary*, and the cost low in proportion to results. With carbon held constant, depth-hardening quality increases as the alloy content is increased.

Sometimes weight and space limitations demand that smaller sections carry heavier loads safely. For safety's sake, the answer *must be* alloy steels. Under repeated stress, high tensile strength and hardness do not necessarily indicate high fatigue properties. The load-carrying ability of a steel depends upon its alloy constituents and the form of the structure at the time it is bearing the load.



A problem of high pressures at elevated temperatures may present a problem. But alloy steels *have proved* their high resistance to creep. Some stainless alloys maintain high strength up to 1800° F. They resist oxidation—therefore do not lose their strength appreciably through reduction of section.

High elastic properties and strength may be the primary requirement, especially for welded structures. Weight reduction may be most important. In these applications, low carbon complex alloy steels *offer distinct advantages.* Such alloy steels at equal or higher yield points show low weld-hardening tendencies. Resistance to corrosion is improved. So is ductility of the weld. And retention of toughness at sub-zero temperatures, as well as creep resistance at high temperatures, is better.

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radson carbon. It should be noted that the coke figures given are gross yield, i. e., the amount of coke produced in the reactor, without adjustment for whatever amount is burned in the heater vessel to provide heat for carrying on the operation.

Extraneous fuel may be used in the heater vessel, in which case the gross coke yield will become essentially the yield available for marketing. This is especially important where the coke made can be disposed of at relatively high realizations. The effect of this will be shown in the discussion on economics.

In contract to coke yield, gas production does not change greatly with change in feed quality. A typical gas analysis excluding H_2S is shown below.

	Mole per cent
H_2	16
CH_4	41
C_2H_4	10
C_2H_6	16
C_3H_6	10
C_3H_8	7

The C_2 cut is about 40 per cent ethylene and the C_3 cut is about 60 per cent unsaturated. The C_3– figures in the yield tables include H_2S. For a low-sulfur-pitch feed, say less than 2 per cent sulfur, the dry gas contains less than about 2 per cent H_2S. For higher-sulfur feeds, hydrogen sulfide contents between 5 and 10 per cent have been measured.

Naphtha yields are shown as the C_4-430° F. final vapor-temperature cuts. The C_4 content of the naphtha runs about 13 vol. per cent. The C_4 cut is normally about 75 per cent unsaturated. Including the C_3, the coker light ends provide an attractive source of polymerization-plant feed.

Gas-oil yields are shown for the 430°-1,015° F. distillation range. A heating-oil fraction could be taken from this wide-cut gas oil. With vacuum-pitch feeds, a 430°-650° heating-oil cut will amount to about 30 per cent on the total gas oil.

Yields on Long Residua

Long as well as short residua can be handled by fluid coking. A typical example of results from this type of operation is shown in Table 2, where comparison is made with delayed coking of the same feed. As would be expected, coke yield is much lower for this long residuum than for the vacuum residua of Table 1. Naphtha and gas yields are also lower, and gas-oil yield is much higher.

It has been found that yields on fluid coking of long residua are quite close to those from a combination of vacuum distillation and fluid coking of the vacuum residuum. Thus, it is indicated that heavy gas oils can be taken overhead in a fluid coker with very little degradation. This is important in cases where it is desirable to simplify refining operations by feeding a long residuum to fluid coking. This avoids the complications of operating two units.

TABLE 2

Fluid and Delayed Coking of a Long Residuum from North Louisiana-Arkansas Crude Mixture

Feed gravity, °A.P.I	15.3
Conradson carbon, wt. per cent	11.5
Sulfur, wt. per cent	2.8
Distillation, °F.:	
Initial	298
5 per cent off at	635
10 per cent off at	710
15 per cent off at	765
20 per cent off at	816
25 per cent off at	865
30 per cent off at	894
35 per cent off at	920

	Est. fluid coking	Delayed coking[a]
Yields:		
C_3, wt. %	6	4.7
C_4, vol. %	2	4.5
C_5-430°, vol. %	14	13.5
430°-1,015° gas oil, vol. %	72	.....
400°-800° gas oil, vol. %	.....	64.6
Coke, wt. %	13	22.6
Product Quality:		
Gas-oil gravity	22	30
Midboiling point, °F.	800	617
Sulfur, wt. %	1.5-2.2	1.6
Characterization factor	11.65	11.65
Naphtha Res. Oct. No., clear	77	.....
Sulfur, wt. %	0.3-0.6	.....
R.v.p., psi.	4	7

Product Quality

While the small units have given sufficient information to allow prediction of preliminary yields for most stocks, information on product quality is somewhat more limited. Several feeds have been studied in some detail and this information has permitted a few conclusions to be reached.

The research octane number clear of C_5-430° fluid coker naphtha is expected to be about 77. It may vary somewhat with feed stock, but is normally close to this level. Operating conditions also affect the octane number of the naphtha. Fluid coker naphtha, including total C_4, will normally run 10-12 lb. R.v.p. Polymerization of C_3 and C_4 unsaturates will increase the naphtha yield and improve quality, especially if extraneous butane is available.

All coker naphthas are unstable as produced, having high gum and low breakdown time. Fluid coker naphtha can be made satisfactory by the usual treating methods. For example, in the case of naphtha from low-sulfur pitches, or where sulfur in the coker naphtha can be blended off in the total gasoline pool, clay treating can be used. For coker naphtha from high-sulfur pitches, desulfurization may be needed.

If hydrofining is used, other treatment for gum and stability will not be required, and the advantage of having in the order of 100 per cent liquid volume yield of treated product will accrue. Another possibility is to include the coker naphtha in the feed to a hydroformer. This is a simple method of providing hydrogen for desulfurization and treating and has the additional advantage that the heat balance in the hydroformer is improved.

Coker gas oils from short residua, where the coker product quality is not masked by virgin gas oil from the feed, are, of course, not of as good quality as virgin gas oils from the same crudes. This is indicated by the gas-oil gravities shown in Table 1. It should be noted, however, that these are wide-cut gas oils with average boiling point in the order of 775° F. Furthermore, higher-quality pitch gives correspondingly higher-gravity gas oil.

Cracking quality . . . Generalized information on catalytic cracking quality of fluid coker gas oils is not yet available. Data on the feed stocks which have been run, of course, show that catalytic coke make from the 430°-1,015° F. fluid coker gas oil is higher than from virgin gas oil from the same crude.

In the section on economics, for example, the figures are based on a catalytic coke make from coker gas oil twice that from the virgin at a given conversion. Presently available data suggest that this is a reasonable basis and it is interesting that it leads to a very favorable outlook for fluid coking.

The actual coke make in catalytic cracking of coker gas oil depends very much on operating conditions and refinery circumstances. Catalytic coke production from coker gas oils is quite sensitive to conversion so that balances on coke-burning capacity can often be met by relatively small decreases in catalytic naphtha yield.

Where the coker gas oil must be cracked along with virgin feed, the choice of catalytic cracking conditions may be limited. In other cases where the coker gas oil is cracked alone, it is possible to select catalytic cracking conditions so as to decrease the coke

yields significantly. Work along these lines is going on at Esso Laboratories. Another method of decreasing catalytic coke is mild hydrogenation of the coker gas oil. Besides improving the catalytic cracking characteristics of the coker gas oil, this technique gives low-sulfur products.

In common with other cracking operations the sulfur concentration in the naphtha is a small fraction of that in the feed. However, sulfur reduction in the gas oil is not ordinarily of large magnitude, and in the coke sulfur is normally higher than in the feed, as shown in Table 3. The gas also carries away more than its proportionate share of sulfur in the form of hydrogen sulfide. The amount thus removed, however, is not a large part of the total sulfur in the feed.

The ash content of three typical cokes is shown in Table 3. The process is run under such conditions that all the ash shows up in the coke and is not found in a significant amount in the overhead products.

Some of the uses which are being actively studied for this material are combustion in different kinds of boiler furnaces, electrodes for aluminum production, and various metallurgical and specialty uses.

Comparison with Delayed Coking

Comparison of fluid and delayed coking is difficult on short residua because, in general, delayed coking is run on long residua only. Handling of vacuum pitch in the delayed-coking operation has apparently raised such problems as to make commercial application of this type operation unattractive. Furthermore, comparison of coker gas-oil qualities from both short and long residua is difficult because of the difference in boiling range in which they are normally produced.

For example, in the case of fluid coking, gas oil of about 1,015° F. end point is produced, whereas in delayed coking the gas-oil end point is typically 800°-850° F. A few comparisons, however, have been found possible and these are presented in Tables 2 and 4.

In Table 2, results of fluid and delayed coking[2] of a vacuum residuum from California crudes are shown. The fluid operation was at about atmospheric pressure and the delayed are pilot-plant data at 70 psi. Both are based on recycling to ultimate yield of gas oil and lighter liquid products. It will be observed that both coke and gas yields in the fluid operation are lower than in delayed.

This is especially true of coke, where the difference amounts to 14 wt. per cent on feed. Fluid coker naphtha yield is also about 10 per cent lower than from delayed coking. As a result, the yield of gas oil from catalytic cracking from fluid coking approaches twice that from delayed coking.

The total liquid product from fluid coking is shown in Table 2 to be more than one-fifth greater than from delayed.

Long residua . . . Comparison of fluid versus delayed-coking yields from long residua is shown in Table 2. Here, similar advantages are shown for the fluid route, although the differences are masked by the relatively large amount of unconverted virgin gas oil in the products.

In delayed coking the usual practice is to run the feed to a product fractionator in a combination-type operation. In the delayed-coking case of Table 2, about 20 per cent of light gas oil would be flashed in this way and does not pass through the coker. In the fluid operation the total residuum is fed to the coking reactor with no prior flashing of the light fractions. However, the combination principle can be applied if desired to fluid coking. No appreciable yield or product-quality difference would be expected.

Regarding product quality, fluid coking appears to have a significant advantage over delayed coking in naphtha octane number. This amounts to about 10 points, although neither octane number is high by present-day standards.

In both the short and long residuum comparisons, it will be noted that qualities of the gas oils, as indicated by gravity-boiling point considerations, are comparable. For example, from the long North Louisiana-Arkansas feed, both processes show gas-oil characterization factors of 11.65. From the California vacuum residuum, characterization factor of both gas oils is 11.3.

The fluid product, of course, has been cut to a much higher end point than is usual in the delayed-coking operation. Furthermore, because of the high end point, the gas oil from fluid coking of the long residuum comprises a much greater proportion of unconverted virgin gas oil than does the product from delayed coking.

The data of Tables 2 and 4 show characterization factors of fluid and delayed coker gas oils about the same. However, correlation of a relatively large number of data from once-through

TABLE 4

Fluid and Delayed Pilot Plant Coking of Vacuum Residuum from California Crudes

Feed gravity, °A.P.I.	5.6
Conradson Carbon, wt. per cent	22.5
Sulfur, wt. per cent	1.7

	Fluid	Tide Water Delayed Coking[2]
Yields:		
C_3 and lighter, wt. %	8	9.2
C_4, vol. %	2.2	3.4
Debutanized naphtha, vol. %	*19.3	†28.2
Gas oil, vol. %:		
400°-750° F.		31.5
430°-1,015° F.	55.0	
Coke, wt. %	26	40.2
Total C_4+ liquid, vol. %	76.5	63.1
Gas Oil:		
Gravity, °A.P.I.	16	29.3
A.S.T.M. Distillation, °F.:		
I.b.p.	480	431
50 per cent	800	525
90 per cent	955	660
Sulfur, wt. %	1.2	0.9
Characterization factor	11.3	11.3
Naphtha:		
Gravity, °A.P.I.	55	59.3
C.F.R.-R. Oct. No., clear	76	66
Sulfur, wt. %	0.6	0.6
A.S.T.M. 90 per cent point, °F.	370	334

*C_5-430° F. V. T. (A.S.T.M. 90 per cent =370° F.) †A.S.T.M. 90 per cent = 334° F.

TABLE 3—EXAMPLES OF COKE QUALITY*

Crude source of vacuum pitch fed—	South Louisiana mixture	Hawkins	Elk Basin
Volatile matter, weight per cent:			
At 1,100° F.	0.6	0.9	1.3
At 950° C. (1,742° F.)	5.0	5.0	5.3
Carbon, weight per cent	92.5	88.3	88.6
Hydrogen, weight per cent	1.6	1.9	1.8
Sulfur, weight per cent	1.4	7.0	6.4
Ash, weight per cent	0.785	0.332	0.370
Ash components, weight per cent metal in coke:			
Nickel	0.021	0.010	0.011
Vanadium	0.003	0.015	0.035
Iron	0.055	0.007	0.003

*Ash and ash components estimated for 100 per cent conversion recycle operation. All other data from once-through operation of the 100-bbl. per day fluid coking pilot plant. Sulfur will actually be somewhat lower in recycle operation.

operations indicates the characterization factor of fluid coker gas oil to be 0.10 or 0.20 greater than that of delayed coker gas oil from the same feed. It appears that this may result from the greater amount of cracking which occurs in delayed coking as indicated by the low end point of delayed coker gas oil.

Economics

In Table 5 the results of calculation of typical fluid coking economics are given. Figures are shown for the South Louisiana and Hawkins pitches, for which estimated process results are given in Table 1. A 10,000-bbl. per stream day coker capacity is used for these examples.

The economics are based on an evaluation of the feed to and the products from the coker itself. The pitch feeds were evaluated as components in No. 6 fuel oil. Values of coker products were calculated from realizations of the final products from coking plus catalytic cracking of coker gas oil, with deductions for light-ends recovery, catalytic cracking, and products treating. These deductions cover operating cost and 10 per cent return after income taxes on investment including general facilities for these three steps.

TABLE 5
Typical Gulf Coast Fluid Coking Economics

Crude source of vacuum pitch fed	South Louisiana Mixture	Hawkins
Yields on pitch:		
C_3, wt. %	8	9.5
C_4-430°, vol. %	24	23
430°-1,015°, vol. %	61	52
Coke, wt. %	16	27.5
Products value, per bbl. pitch:		
C_3, at 90¢ per bbl. feed equiv.	$0.07	$0.09
C_4-430° at $3.20 per bbl.	0.77	0.74
430°-1015°, at ($ per bbl.)	†1.65	‡1.40
Coke, at $5.00 per T	0.14	0.25
Total	$2.63	$2.12
Each $ per T. coke adds	$0.027	$0.049
Each ¢ per gal. 430°-1,015° adds	0.256	0.218
Feed value, per bbl.	1.25	0.75
Value added by fluid coking, per bbl.	1.38	1.37
Coker operating cost, per bbl. pitch	0.24	0.24
Gross profit, per bbl. pitch*	$1.14	$1.13
Coker investment, battery limits, per bbl. per calendar day	$235	$250
Return before taxes,* % per year on B.L. Inv., %	175	165
Return after 55% income taxes*, %	80	75

*Excluding royalty. †(2.70). ‡(2.00).

"Fluid coking seems to have a significant advantage over delayed coking in naphtha octane number. This amounts to about 10 points, although neither octane number is high by present-day standards."

From Table 5, it will be seen that the values of the products from fluid coking run somewhat over $2.00 to $2.50 per barrel of pitch in the two cases. The two feed values are 75 cents and $1.25 for the Hawkins and South Louisiana, respectively. The gross profit per barrel of pitch, after subtraction of operating cost of 24 cents, comes to $1.14 and $1.13 per barrel of pitch. Return before income taxes runs around 170 per cent per year on the coker battery limits investment, and around 75 to 80 per cent after allowance of 55 per cent income taxes.

In the case feeding South Louisiana pitch, desulfurization of the products is not necessary. In calculating the value of the coker naphtha, allowance was made for clay treating. In the Hawkins case, hydrofining of the coker and catalytic naphthas was provided for. The catalytic heating oil was also assumed to require hydrodesulfurization. The hydrogen requirement for these hydrotreatments was assumed to be supplied from existing hydroforming, or equivalent operation. This is typical of many refining situations.

As to investment, a figure of $2,300,000 is used for a 10,000-bbl. per stream day plant handling the higher Conradson carbon feed which was used. An approximate adjustment was made to allow for the lower Conradson carbon in the other case.

These investment figures may vary, of course, with changes in construction standards. Larger plants, of course, are cheaper on a unit-cost basis. The investment for the fluid coker is based on injection of hot feed, and includes the reactor and heater sections, the overhead scrubber-fractionator, and equipment for withdrawing coke product and feeding seed coke. The scrubber-fractionator provides recycle, 430°-1,015° F. gas oil, and fractionator naphtha cuts.

TABLE 6
Coker Operating Requirements

Feed rate: B/S.D.	10,000
Investment, MM.	$2.3
Operators/shift	3
Utilities:	
Fuel, MM. B.t.u. per hr.*	110
Steam, lbs. per hr.†	21,000
Cooling water g.p.m.	6,000
Power, kw.	1,500

*Normally coke burned in process. †Assumes no waste-heat boiler. About 14,000 lb. per hr. steam could be generated in a waste-heat boiler on the flue gas from the burner.

Table 6 is a list of the operating requirements of a fluid coking plant. The operating cost used in Table 5 is based upon these requirements, and includes provision for depreciation, payroll burden, and general refinery overhead, as well.

These economic results are typical of what would be expected for Gulf Coast conditions with fuel at about $1.75 per barrel, and 93 research octane number gasoline at 12¼ cents per gallon. There will, of course, be some variation in economic outlook, depending on plant location, etc. Thus, for Mid-Continent conditions, where fuel oil is relatively low valued, the outlook will be considerably improved. Again, at points where fluid coke can be favorably disposed of, a price as high as around $15 per ton might be realized. This would increase the value of coker products by about 50 cents per barrel of pitch, and increase the return, after income taxes, by about 33 per cent.

The method of caring for the sulfur problem can also lead to important changes in the economic outlook. As an example, for feeds which are relatively low in sulfur, but otherwise similar to the Hawkins, or where the high-sulfur products can be blended off, the value of coker products would be increased by about 30 cents per barrel of pitch. This increase would raise the returns by about 20 per cent on coker investment.

The value of the pitch feed is also an important economic factor. For example, in the Hawkins case, the 75 cents per barrel value is based on fuel-oil blending without regard to a possible sulfur limitation. Where the sulfur in fuel oil is critical, a high-sulfur feed to coking would have a lower value.

References

1. "Fluid Coking of Residua," A. Voorhies, Jr. and H. Z. Martin. The Oil and Gas Journal, November 16, 1953.

2. Private communication, courtesy, Tidewater Associated Oil Co.

Cuttings from gas-bearing formations will yield bubbles when placed in the cup and vacuum applied. A microscope is necessary to detect these bubbles.

Examination of Cuttings Under Vacuum Eliminates Many Blank Drill-Stem Tests

by Jack E. Bliss

APPLICATION of a vacuum method of logging gas from cuttings is helping to eliminate many of the blank drill-stem tests for operators in West Texas.

A new development in hydrocarbon well logging, the vacuum method ascertains whether a logged gas or oil show is actually from the bottom of the hole. If cuttings from the bottom do not prove under vacuum to be gas bearing, the operator may conclude that the show is from up the hole and that the formation being drilled is not a likely prospect for drill-stem testing.

The vacuum method examines representative well washed sample of fresh cuttings, which are placed in a glass coaster and submerged in about a quarter inch of water. The coaster is placed in a vacuum chamber having a transparent plexiglass lid. As vacuum is gradually applied, the operator may examine the cuttings through a microscope for gas bubbles. Gas bubbles will emerge from any cuttings that are gas bearing.

By use of the vacuum method many of the blank drill-stem tests run on sections where oil and gas shows were logged could have been eliminated. This is due to the fact that the operator can carefully examine the cuttings that are giving the gas show, or he can determine whether the gas show is not a true gas show from the bottom.

Log No. 1 is a good example of a log in which the zone with the oil show and apparent gas show need not have been drill-stem tested. It will be noticed that all bubbles from the vacuum chamber tests were extracted from the shale cuttings. No bubbles were pulled from the limestone cuttings, although it was the limestone cuttings that yielded the oil show.

In the "gas from mud" column it will be noted that there is certainly a possible gas show (starting at 6,078 ft.). These "gas from mud" readings are undoubtedly due to slugs of recirculated gas in the mud system and gas swabbed in during trips from high-pressure (and often tight) sections higher in the hole; however, the possibility of this not being a true gas show could not be safely assumed without use of the vacuum method.

The fact that the vacuum chamber showed no bubbles from the limestone cuttings (which yielded the oil cut) was conclusive evidence that this oil show and apparent gas show was not worth testing. The drill-stem-test results showed all pressures except the hydrostatic pressure to be zero. The cost of this test could have been saved.

Cost saved . . . Log No. 2 is a good example of a case where the cost of a drill-stem test was eliminated by use of the vacuum method. Throughout this section the cuttings lithology was limestone, sand, and shale, and there was no particularly significant changes. The oil-fluorescent cuts were from the limestone and sand cuttings. With the use of the vacuum method, no bubbles could be extracted from the limestone cuttings, so any limestone in this section could be eliminated as being possibly productive. All the gas bubbles were from the sand and shale cuttings.

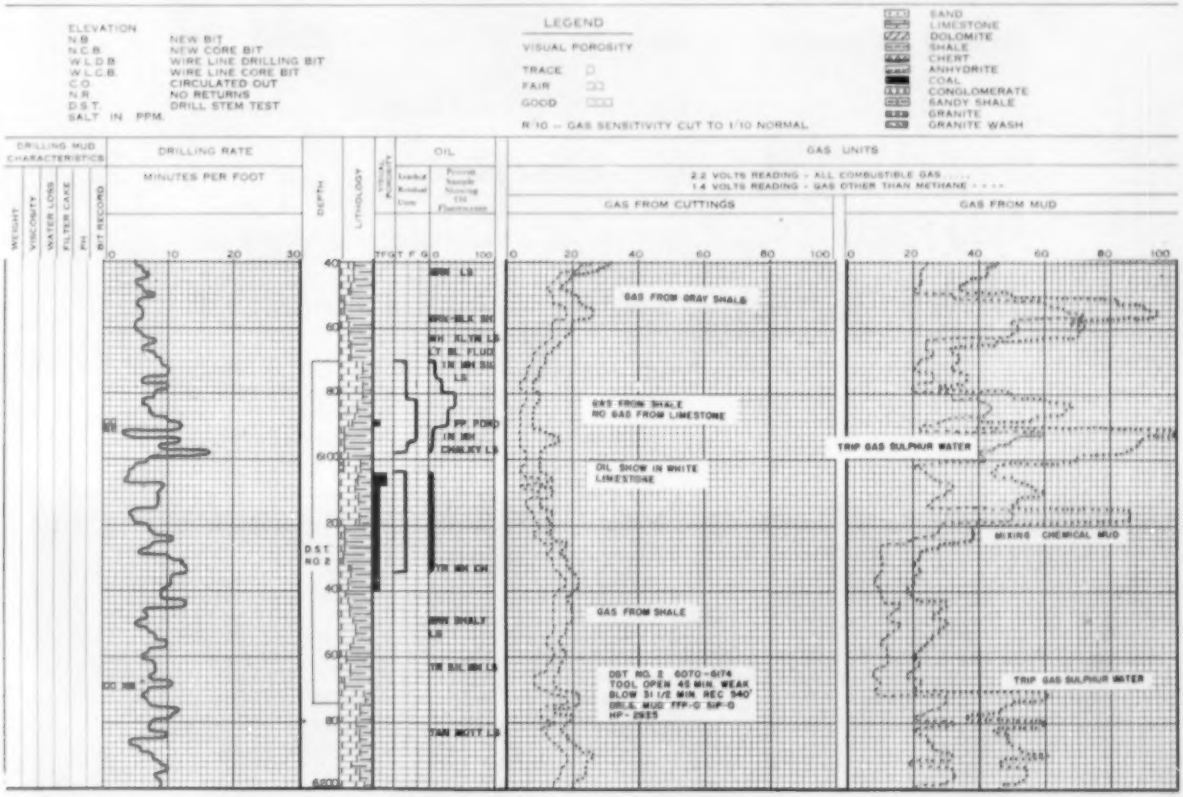
At 6,560 ft. there was a definite gas increase in both the "gas from cuttings" and "gas from mud"; however, when an analysis of the vacuum-method data is made, it will be noticed that the gas show was due to an increase in gas from the shale cuttings. Above

Author is with Rotary Engineering Co., Midland, Tex.

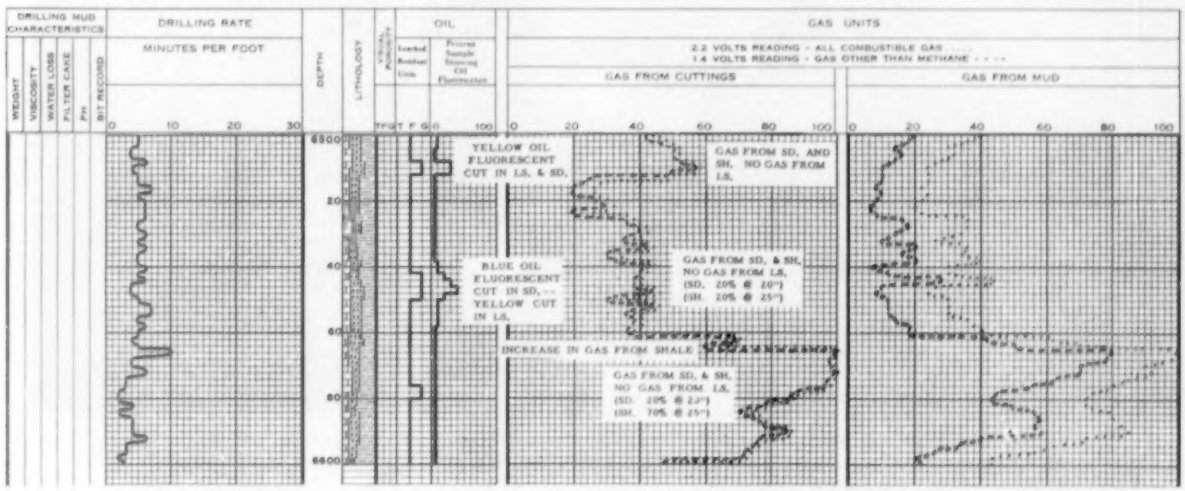
6,560 ft. only about 20 per cent of the shale cuttings yielded bubbles when vacuum was applied, but below 6,560 ft. about 70 per cent of the shale cuttings yielded bubbles. There was no significant change in the bubbling from the sand cuttings. These data pointed out that the gas show was from the shale and not from the oil-bearing sand cuttings. There was no need of running a drill-stem test on this section and none was run.

A method has also been developed for pressurizing the submerged gas-bearing cuttings which enables the operator to preserve any gas-bubble tests for the company representative to examine when they reach the well site.

Not all blank drill-stem tests can be eliminated. In many cases the cuttings which gave the oil cuts will also prove to be the source of the gas show when tested in the vacuum chamber. If these cuttings are from a formation that could be productive, the drill-stem-test results may be good or bad. Some blank tests will be obtained even under these most favorable conditions due to lack of permeability or lack of bottom-hole pressures.



Log No. 1, a good example of a log in which the zone with the oil show and apparent gas show need not have been drill-stem tested.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WEIGHT
VISCOSITY
WATER LOSS
FILTER CAKE
PH
BIT RECORD
DRILLING RATE
MINUTES PER FOOT
DEPTH
LITHOLOGY
OIL
GAS UNITS
2.2 VOLTS READING - ALL COMBUSTIBLE GAS
1.4 VOLTS READING - GAS OTHER THAN METHANE
GAS FROM CUTTINGS
GAS FROM MUD
YELLOW OIL FLUORESCENT CUT IN LS. & SD.
GAS FROM SD. AND SH. NO GAS FROM LS.
BLUE OIL FLUORESCENT CUT IN SD., -- YELLOW CUT IN LS.
GAS FROM SD. & SH. NO GAS FROM LS. (SD. 20% @ 20") (SH. 20% @ 25")
INCREASE IN GAS FROM SHALE
GAS FROM SD. & SH. NO GAS FROM LS. (SD. 20% @ 20") (SH. 70% @ 25")

Log No. 2, a good example of a case where the cost of a drill-stem test was eliminated by use of the vacuum method.

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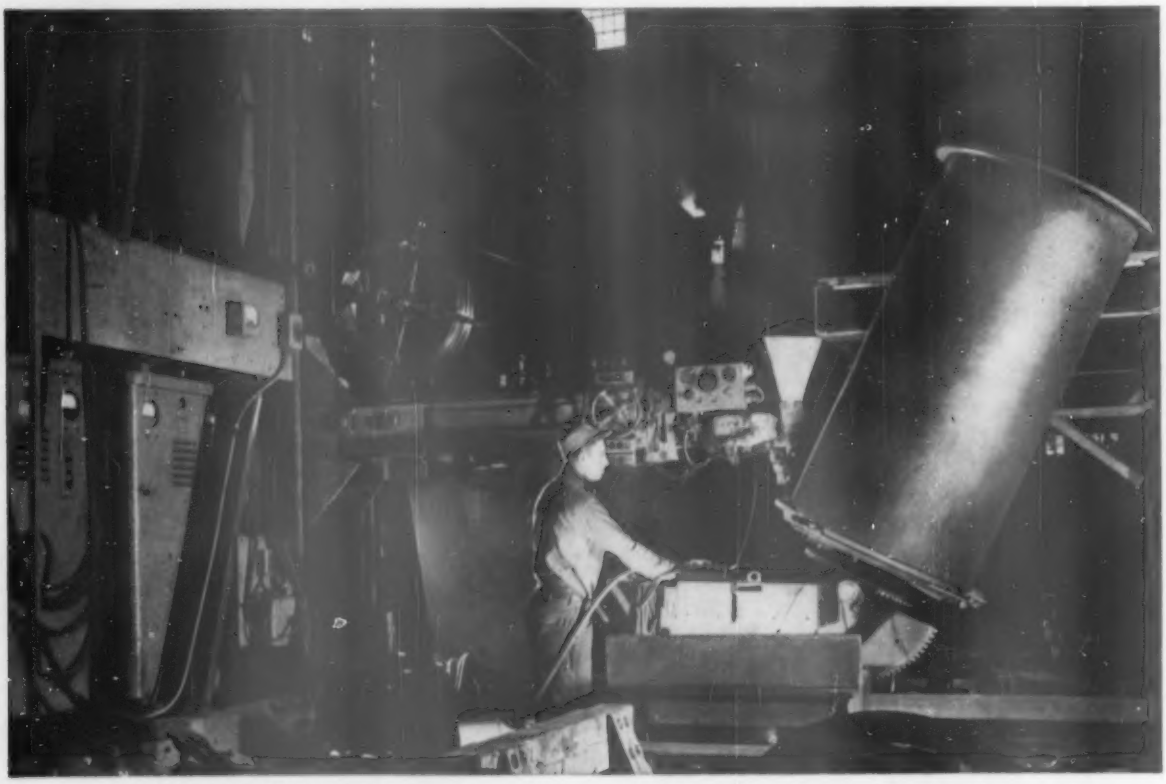

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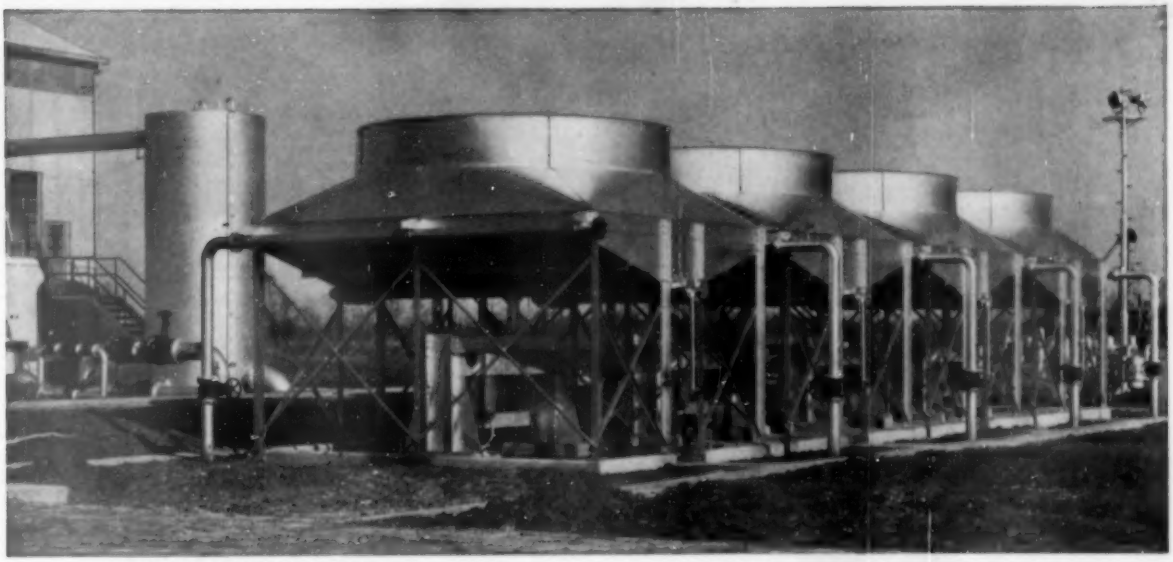

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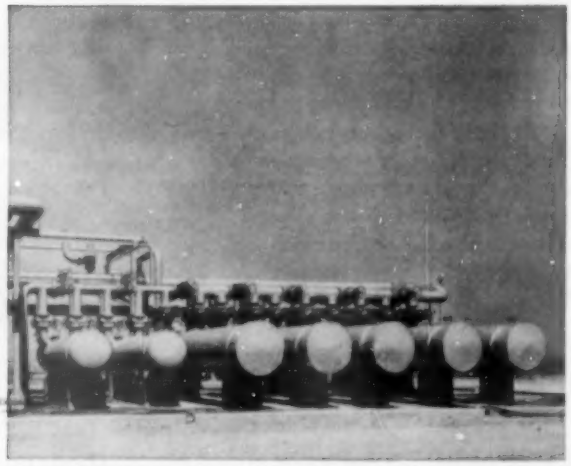

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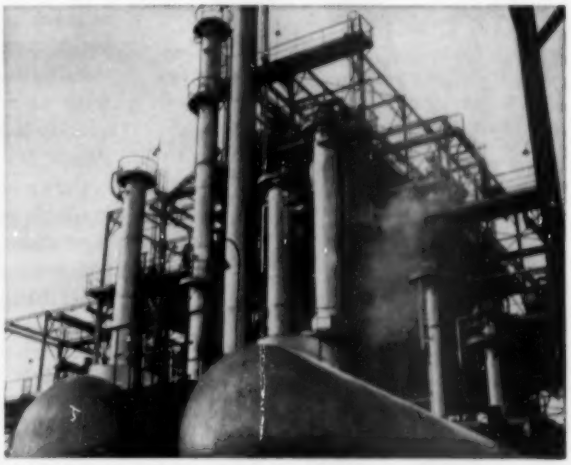

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ELECTRIC LOGGING—27

Origin of Spontaneous Potential

by R. I. Martin

THE basic work of the Schlumberger brothers, carried out in the year 1932, appears to have been overlooked for many years. Probably the reason is that such a variety of S.P. effects were found in the field that it was considered impossible to reduce them to a common denominator.

In the year 1943 interest was revived by the simultaneous publication of two significant articles. One by Dickey[1] related an account of obtaining an S.P. curve in a dry mine shaft. This was interpreted to show that contact potentials may play an important role under certain circumstances. It is possible, however, that the effect was magnified by the type of electrodes used.

The second article, by Mounce and Rust,[2] is worth recording in some detail. For these experiments they used a circular trough divided into three sections by permeable walls of unglazed porcelain. A plan view of this is shown in Fig. 1. When the three sections were filled with different electrolytes, or with solutions of different concentrations of the same electrolyte, no current was observed to flow in the system.

Author is assistant professor of petroleum engineering, Missouri School of Mines and Metallurgy.

Potential differences could be measured between different sections, but no potential difference could be measured in any one section. The electrochemical e.m.f. does not cause any current to flow.

Similar results were obtained if clean sand was used for partitions. On the other hand when one of the walls was made of shale, large potential differences were observed in all the sections, indicating that a current was flowing. In this case a sodium-sodium chloride concentration cell results, from the sodium ions in the clay.

In order to investigate further one entire section was filled with shale, another with fresh water, and the third with salt water. The two latter sections were separated by a permeable membrane in order to prevent diffusion. This is the final condition shown in Fig. 1. It was then observed that a current was flowing from the shale to the fresh water, then to the salt water, and back to the shale. If solutions of equal concentration were used, no current flowed regardless of how concentrated or dilute they might be.

The total electromotive force of the system when commonly occurring concentrations were used was of the order of 200 mv. As this is the same order of magnitude as that found in practice, Mounce and Rust's experiments afford satisfactory proof both qualitatively and quantitatively.

The similarity between the experimental conditions and those occurring in and around the bore hole is apparent from the circle drawn on Fig. 1b. In actual fact many current flow lines could be drawn around the shale-mud-sand contact, and also around the lower contact of the bed which is not shown in Fig. 1. For each contact, such as the upper one shown in sections, these current flow lines will be confined to one-half of the bore hole and to one-half of the sand thickness. Consequently they will be crowded in these two regions, but may spread out through the shale. Similar conditions will obtain on the other side of the section, and also on the lower contacts of the sand.

It is convenient to consider first, an idealized case in which it is supposed that the S.P. current could be prevented from flowing. In this case an abrupt change in S.P. will take place at each contact. The S.P. in front of the sand will be constant and at a lower value than that in front of the shales.

This distribution of S.P. is shown in the illustrations of the following installments as a rectangular diagram. It is directly comparable with similar rectangles on the resistivity illustrations used earlier, and is useful to indicate the maximum electromotive force which could be expected under the ideal conditions postulated. It will be referred to as the static S.P. diagram.

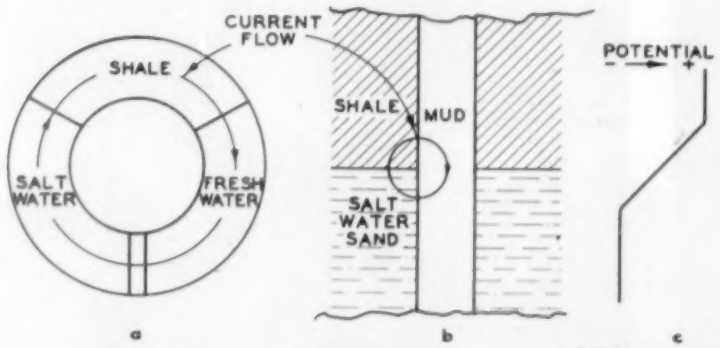

Fig. 1—Experimental device used to investigate the origin of the self-potential effect. (From "Electric Well Logging," a copyrighted manual by Herbert Guyod.)

References

1. Dickey, P. A., "Natural Potentials in Sedimentary Rocks," Petroleum Technology, September 1943.

2. Mounce, W. D., and Rust, W. M., Jr., "Natural Potentials in Well Logging," Petroleum Technology, September 1943.

Small Flow Controller for High-Viscosity Liquids

by Robert L. Patton

IN a pilot-plant operation several different charge stocks were used, one of which was an oil of a very high viscosity. Normally the charge was flow-controlled with a conventional orifice plate, differential-pressure transmitter, recording receiver-controller, and diaphragm control valve in the steam supply line to the charge pump. This system was found inadequate for controlling the flow rate of the high-viscosity stock, primarily because of the variations in differential pressure across the orifice plate caused by changes in viscosity with oil temperature. There was no convenient means for controlling charge-stock temperature.

A way was found to obtain very good flow control with only slight modification of the receiver-controller. The differential-pressure transmitter was removed from the orifice plate and connected to the charge-stock drum to measure the hydrostatic head in the drum, which was a vertical cylindrical vessel of sufficient capacity for one complete run. The circular chart was removed from the receiver-controller and in its place a sheet-metal cam was installed, turned by the chart-drive motor, which moved the control index at a predetermined linear rate of speed. Several different cams were cut, to provide the various charging rates required. The recording pen was removed and a pointer installed in its place, so the relative positions of index and variable could be observed.

It was found that the pointer followed the index quite closely after the controller was properly tuned, and good control was obtained. The transmitter air was also teed into a nearby recording receiver to obtain a record, and the curves drawn on this chart could be compared with those of the cam. A true weight-rate-of-flow control was obtained, independent of temperature variations and without the necessity for calculating an orifice coefficient.

Author is general foreman of instrument department, Gulf Oil Corp., Port Arthur, Tex. Paper presented at Texas A. & M. instrumentation symposium, 1954.

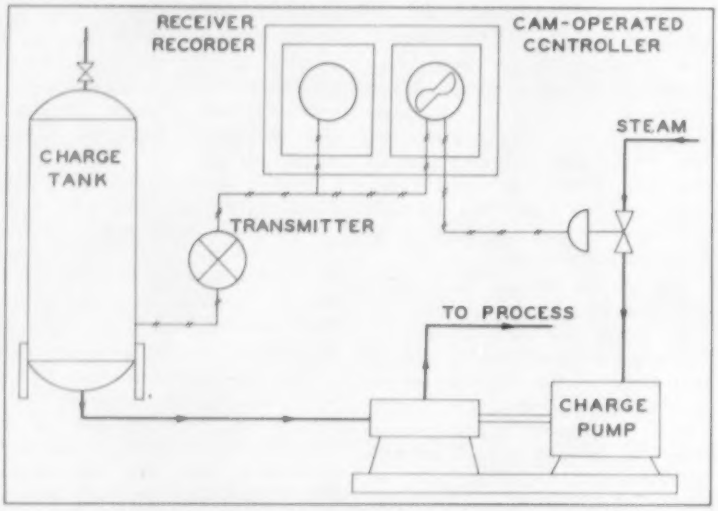

Fig. 3—Schematic of special flow-control hookup.

Fig. 1—Details of cam and index pointer.

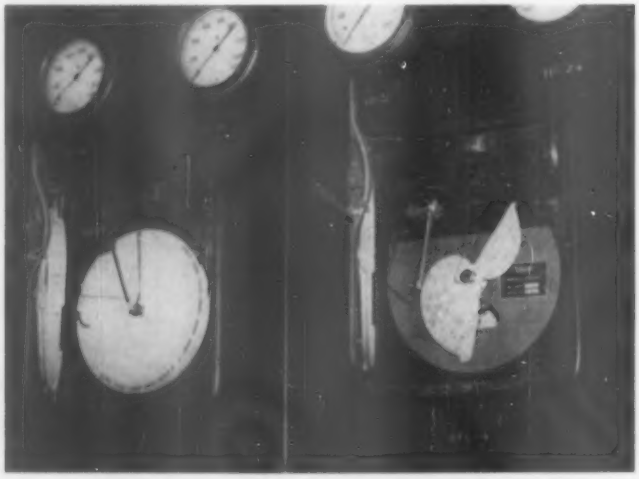

Fig. 2—Chart record can be compared to cam curve.

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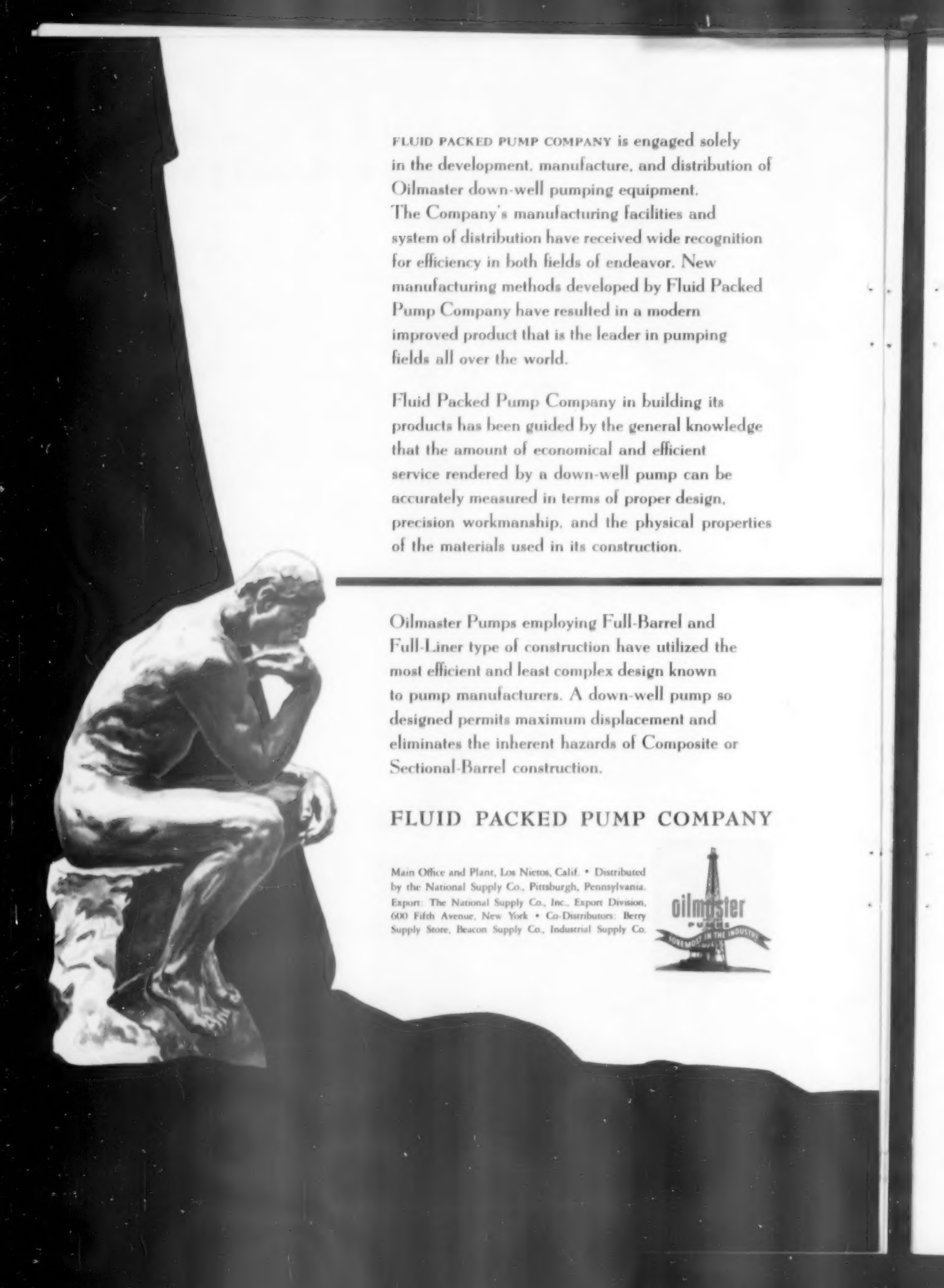

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oilmaster PUMPS FOREMOST IN THE INDUSTRY

Acid, Water, and Sulfide Corrosion Combined

by W. L. Nelson
Technical Editor

ALTHOUGH a small amount of hydrochloric acid is evolved during the distillation of brine-bearing crude oils, it is seldom possible to employ alloys that are specifically useful for "acid" corrosion because hydrogen sulfide is also present. The hydrochloric acid, along with moisture, proceeds into the condensing, rundown, and reflux system where water is used for cooling. Accordingly, a "triple threat" corrosive condition usually arises, namely, the combined attack of dilute hydrochloric acid, hydrogen sulfide, and the various attacks of cooling water.

Although special methods and alloys are valuable, several indirect methods of combating these several corrosions are useful. Among these indirect methods are (1) the removal of as much salt as possible by complete desalting or settling, (2) careful treatment of the cooling water or adjustment of its pH value, and (3) the use of ammonia or lime to partly neutralize the hydrochloric acid. An excess of ammonia constitutes even another corrosive agent with respect to the copper-base alloys. Still another means of combating two types of corrosion which occur at the same time, is the use of bimetallic materials in the form of tubes. Thus, admiralty metal, red brass, aluminum bronze, or cupro nickel are suitable on the "water" or outside of tubes with aluminum, nickel, steel, or stainless steel exposed to the "oil" or "sulfide" side of the tube. The spraying of metals (aluminum, brass, monel, stainless steels, etc.) holds promise for some services but it has been most successful in "building up" or repairing worn machine parts. Finally, the great cost of solid plate constructions such as vessel walls or exchanger shells, can be reduced by the use of clad paste (see Progress in Metals, October 19, 1953).

The types of alloys that have been used to combat this combination of corrosive actions is indicated in Tables 1 and 2 and the kinds of copper-base alloys purchased in 1939 were (J. T. Kemp, tenth midyear meeting, A.P.I., Fort Worth, May 29, 1940):

	Per cent
Admiralty metal	78
Red brass	7
Cupro nickel	10
Others	5

TABLE 1—PERCENTAGES OF ALLOYS USED BY ONE REFINER FOR CONDENSER AND COOLER TUBES*

	1930	1933	1936
Steel	18.0	16.3	12.0
Stainless steel (18-8)	60.3	14.9	5.6
Copper-base alloys	21.7	68.8	82.4

*H. M. Wilten, Mining Met., March 1937, p. 143.

Dezincification of copper-base alloys tends to occur in nonscale-forming types of fresh or salt water or when the scale is porous or loose. Zinc tends to be leached out, particularly under spots of carbonate scale, leaving a layer or plug of porous copper. Admiralty metal is more subject to such attack than copper-rich (red) brasses and small amounts of arsenic or antimony are helpful in inhibiting attack by dezincification. Aluminum brass or bronze is best suited for sea water or bay water. Copper silicon manganese alloys are useful as fasteners for cooling-tower structures or submerged condensers. Exchanger-tube sheets are usually constructed of Muntz metal, or in extreme conditions of cupro nickel or monel metal.

The copper-base alloys are attacked by hydrogen sulfide and hence if sulfide corrosion occurs or if acid corrosion is severe, cupro nickel, monel metal, or inconel are used in the upper tower, condenser, cooler, and reflux systems of topping or rerun plants. Finally, if the temperature is also high (above about 450° F.) as in certain vacuum plants, stainless steel (13 per cent Cr or 18-8 Cr-Ni) equipment or linings are required in withstanding combined acid-sulfide water corrosion.

TABLE 2—COPPER-BASE AND NICKEL ALLOYS FOR "ACID"-"SULFIDE"-WATER CORROSION

Material—Example of resistance or service—	Chemical composition, per cent					
	Cu	Zu	Sn	Ni	Fe	Others
Red brass—Alkaline spray pond or cooling tower water*	85	15	....	....	....	....
Admiralty metal—Many condensers and coolers*	71	28	1	....	....	....
Antimonial admiralty—Dezincification	72	27	1	....	....	(0.05 Sb)
Yellow or common brass—Exchanger baffle or turbulence plates	65	35	....	....	....	....
Muntz metal—Exchanger tube sheets*	60	40	....	....	....	....
Copper silicon manganese—Bolts, nuts, screws or rods of submerged condensers or cooling towers	96	....	1	....	....	(1 Mn or 1 Sn)
Aluminum brass—Sea or bay water	76	22	....	....	....	(2 Al)
Aluminum bronze	95	....	....	....	....	(5 Al)
Nickel silver	65	20	....	15	....	....
Cupro-nickel—Severe water or "acid" corrosion	70-80	....	....	20-30	....	....
Monel metal—Severe water-"acid"-"sulfide" for exchanger or tower shells and bubble trays	29-30	....	(1 Mn)	63-67	1-1.5	(0-4 Si)
Inconel—Most severe "acid"-"sulfide" corrosion	0.2	....	....	79.5	6.5	(13 Cr)
Hastelloy B—Wrought machine parts—severe "acid"-"sulfide"	....	....	(32 Mo)	60	6	....
Hastelloy C—Cast parts—severe "acid"-"sulfide"	....	(5W)	(19 Mo)	51	6	(17 Cr)

*Better resistance to dezincification if inhibited with small amount of arsenic (0.02-0.2) or antimony.

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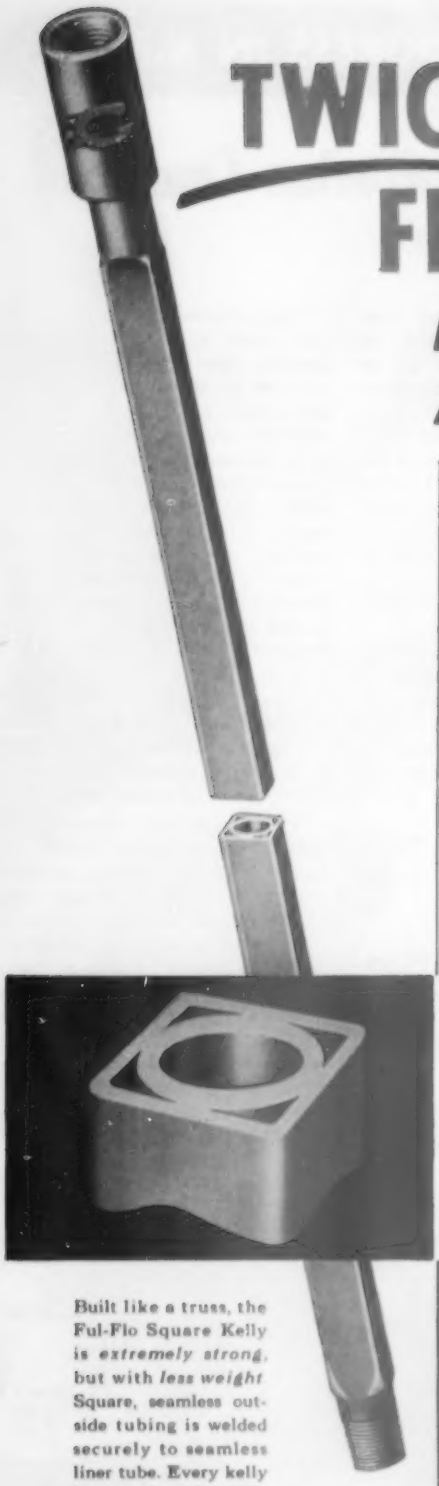

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Drilling-Mud Pressures While Circulating

by George S. Ormsby

INCREASED hydraulic efficiency can be obtained by basing the design of drill-pipe strings and hole programs on plastic flow calculations with specific drilling conditions and mud properties.

Author is with Phillips Petroleum Co., Houston. These illustrations are from a paper presented at the A.P.I. Division of Production, Southwestern District meeting, Houston, March 3-5, 1954.

The sets of conditions chosen for the calculation of illustrations for this presentation were chosen for no other purpose than to approximate conditions that are encountered at some point in most deep Gulf Coast drilling. These conditions are shown in Table 1.

The pressure-drop relations shown in Fig. 1 for the various parts of the mud system are typical and illustrate the possibilities for increasing efficiency by hydraulic balancing. The increase in bottom-hole pressure (total annular drop) due to circulating is also shown, and must be considered when increasing drill-pipe sizes.

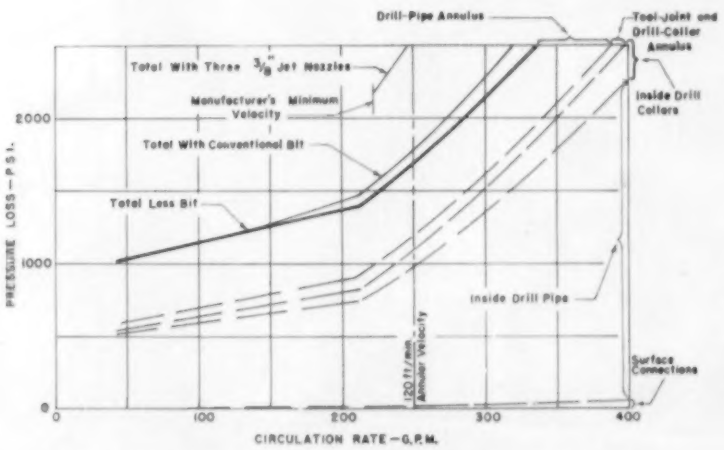


Fig. 1—Breakdown of pressure losses in drilling string with poor mud.

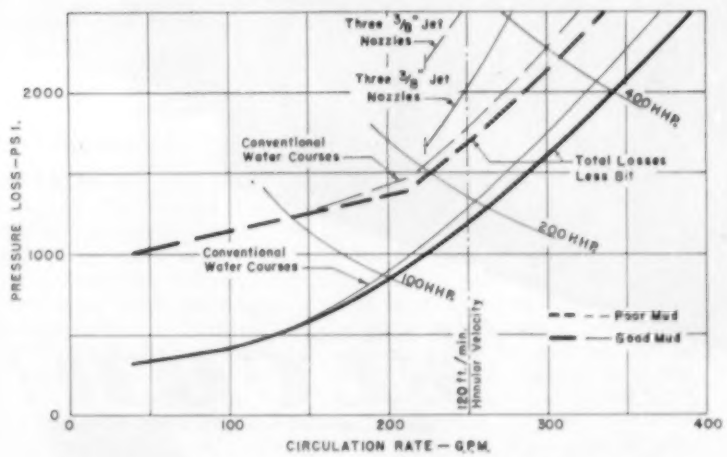


Fig. 2—Comparison of pumping pressure losses with good and poor muds.

In Fig. 2, pumping pressures were calculated and the total pressure drops for the good and the poor muds were graphed on the same scale. Notice that ⅜-in. jet nozzles are only a bare possibility with the poor mud, but could be definitely recommended with the good mud. Jet nozzles of ½-in. diameter could not be considered because the circulating rate at the manufacturer's minimum recommended velocity placed the total pressure drop above 2,500 psi. with the good mud.

In the field, viscosity drops usually are not accompanied by circulating pressure drops; rather, the driller tends to maintain the standpipe pressure by speeding up his pumps.

TABLE 1
Dimensions

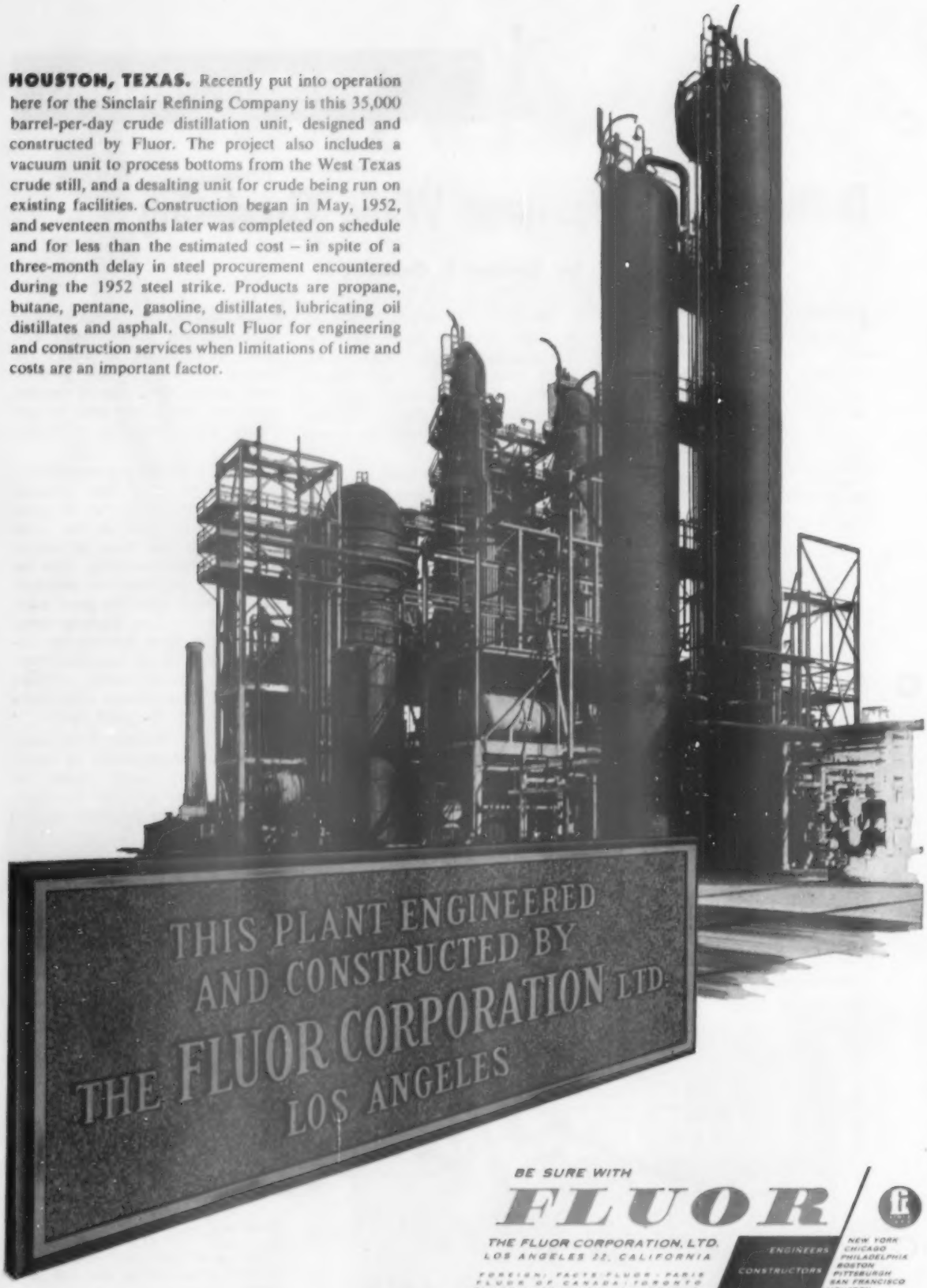
Section	I.D., in.	Length, ft.	O.D. in.	Length, ft.
Standpipe and kelly	3.8	85	.....	.....
Hose, washpipe and gooseneck	3.0	61	.....	.....
Drill pipe (internal flush)	3.8	14,640	4.5	13,827
Tool joints	.....	.....	6.125	813
Drill collars	2.75	360	6.50	360
Hole	8.5	15,000	.....	.....

Mud Properties

	Density lb. per gal.	Plastic viscosity cp.	Yield point lb. per 100 sq. ft.
Good mud	17.5	42	8
Poor mud	17.5	68	27

The "good" and "poor" muds are only relatively so considering their flow properties.

HOUSTON, TEXAS. Recently put into operation here for the Sinclair Refining Company is this 35,000 barrel-per-day crude distillation unit, designed and constructed by Fluor. The project also includes a vacuum unit to process bottoms from the West Texas crude still, and a desalting unit for crude being run on existing facilities. Construction began in May, 1952, and seventeen months later was completed on schedule and for less than the estimated cost – in spite of a three-month delay in steel procurement encountered during the 1952 steel strike. Products are propane, butane, pentane, gasoline, distillates, lubricating oil distillates and asphalt. Consult Fluor for engineering and construction services when limitations of time and costs are an important factor.



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REFINING

Resid Imports Hit

Foreign competition tagged "unfair" by Mine Workers

WASHINGTON.—The "unnecessary and unfair competition" of imported residual fuel was attacked here during a meeting of the governors of the coal-producing states.

The attack was launched by the United Mine Workers of America, who characterized foreign residual as "waste" oil "produced under sub-standard working conditions in a dictatorship nation."

The meeting, held on the eve of a 3-day White House conference of state governors, heard several attacks on oil imports as depressing the coal industry to the point where speakers said the national security is threatened.

Major points of the fight against imports were:

. . . **Foreign residual** has displaced more than 30,000,000 tons of coal a year.

. . . **Imported natural gas** presents another major threat to the stability of the coal industry.

. . . **Our petroleum supply** is limited and we are already dependent upon imports of oil to meet the needs of the armed forces.

. . . **Communist aggressors,** with the largest submarine fleet in history, are capable of shutting off foreign oil imports virtually at a moment's notice.

A drive to return the railroads to the use of coal as fuel and legislation to "equalize" the coal operators with their competitors were advocated by Harry M. Moses, president of the Bituminous Coal Operators Association.

Contract Agreement Made

PORT ARTHUR.—Gulf Oil Corp. and the C.I.O. Oil Workers International Union have agreed to a new contract covering approximately 4,000 employes at Gulf's big refinery here. It will be signed when the necessary papers are drawn up.

The contract will cover an 18-month period. Wage provisions were not involved, but will be subject to talks July 15. Benefits covered in the new pact include hospitalization, sickness and accident clauses.

The Gulf workers are affiliated with O.W.I.U. Local 23.

Union to Build Unifiner

LOS ANGELES.—Union Oil Co. will construct a $100,000, 450-bbl. per day unifining unit at its Cut Bank, Mont., refinery.

The process, developed by Union, reduces the impurities found in many middle refinery stocks by removing the sulfur and nitrogen and by saturating some of the double bonds. The Unifiner will utilize excess hydrogen gas produced by the catalytic reforming unit being built at the refinery by Ralph M. Parsons Co.

Refining Briefs

SAN FRANCISCO.—Shell Oil Co. is making rapid progress in the construction of a 4,500-bbl. Platformer at its Martinez refinery near here. Ground was broken shortly after the first of the year. With all main towers and vessels already in place, it is expected the unit will be completed by mid-June.

WICHITA. — Derby Oil Co. will build a Platformer at its refinery here as a portion of its 1954 expansion program, according to the company's annual report. The refinery has a present capacity of 16,000 bbl. daily.

NEW YORK.—Witco Chemical Co. of New York has increased the output of its asphalt plant at Perth Amboy, N. J., by one-third through construction of a 60 by 100-ft. addition to the cooling and shipping shed.

LOS ANGELES.—Tide Water Associated Oil Co. has introduced a 10-30, high-detergency all-season motor oil in the eastern market. The 100 per cent paraffin base Veedol meets SAE 10W, 20W, and 30 viscosity requirements.

Petrochemicals

Acetone Price Drops

NEW YORK. — Acetone, presently in adequate supply, was reduced ½ cent to 8 cents per pound last week by major manufacturers. Production of acetone, which has averaged 43,550,000 lb. per month, declined to 36,921,803 lb. in January and 33,392,545 lb. in February.

In 1952, the latest year on which a breakdown is available, the U. S. Tariff Commission reported that 92 per cent of all synthetic acetone produced

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in this country was synthesized from isopropyl alcohol, a petrochemical. The production from fermentation and other sources is believed to have dwindled still further, and may be negligible during 1954.

New Plant Opened

Foster Grant puts styrene monomer works on stream

BATON ROUGE. — A new petrochemical plant for the production of styrene monomer has been opened here by Foster Grant Co., Inc., one of the leading producers of molded thermoplastic products. The company is the first in the United States to establish its own primary supply of raw materials.

Styrene is a colorless liquid derived from petroleum products and is the chemical source of polystyrene, the principal molding powder used in injection molding of plastics. The new plant, which represents an investment of $4,000,000, will turn out about 2,000,000 lb. of styrene a month.

The styrene monomer is produced through a three-step operation that starts with ethylene gas and liquid benzene being moved into the plant from the nearby refinery of Esso Standard Oil Co. These materials are reacted together in an alkylation process to produce ethyl benzene. The alkylated product is then separated into fractions by a distillation process, with pure ethyl benzene being recovered. The untreated benzene and undesirable higher alkylate products are separated and recycled back to the alkylation reactor.

In the second step, ethyl benzene is mixed with steam, heated, and passed over a selective catalyst bed. A dehydrogenization reaction takes place, converting part of the ethyl benzene to styrene while splitting out hydrogen. The reaction gases leaving the catalyst bed are cooled. Condensed steam is separated from the ethyl benzene-styrene mixture.

Styrene is separated from the untreated ethyl benzene in the final step. A small amount of byproduct material also is separated and the recovered ethyl benzene is recycled back to the dehydrogenization reactor.

The styrene monomer produced here is shipped to Foster Grant's main plant at Leominster, Mass., where the monomer is reacted to form long-chain molecules known as styrene polymer. The process converts liquid styrene into polystyrene, a solid substance. After further refining, the plastic is heated and injected under high pressure into molds.

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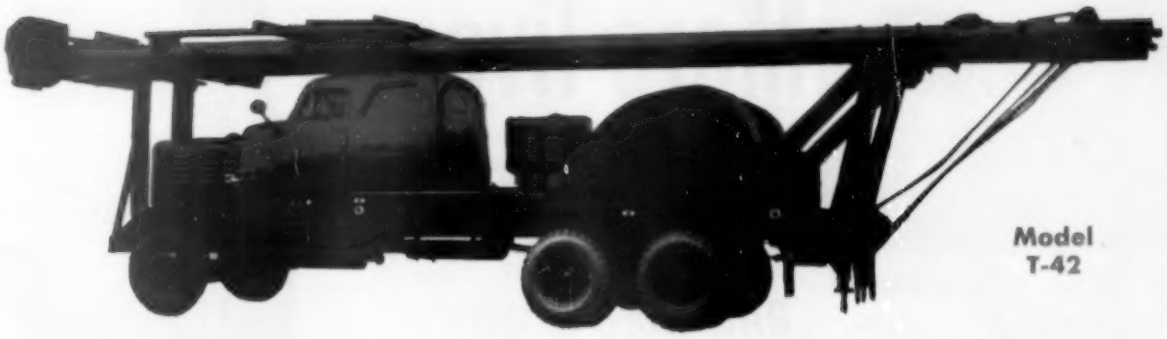
for 6,000′ to 10,000′ Servicing



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TORQUE CONVERTER—TORQMATIC TRANSMISSION FOR MAXIMUM EFFICIENCY, SPEED AND EASY OPERATION.—The three speed Torqmatic Transmission can be shifted under full load and at full speed without slowing down or declutching any drive. No time is lost in stopping to shift gears. Maximum efficiency is maintained at all times, since the engine and Torque converter can be run at the most efficient speed, regardless of load.

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Oil country men...men who know, first hand, what oil well operations demand...designed all the 12 different types of Lane-Wells Packers and laid down the tough specifications for every part. That kind of engineering pays off in long, satisfactory service life, as is shown in the hundreds of reports from operators. They tell of Lane-Wells Packers used on job after job, setting surely, packing off well fluids for long periods of time, pulling easily and coming up ready for further service. Truly, Lane-Wells Packers have nine lives!

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Among the Drilling Contractors

Five New Rotary Rigs Purchased by Calvert

Calvert Drilling, Inc., Olney, Ill., announces the opening of a Rocky Mountain division office and the acquisition of five new rigs.

The new office is located in the Johnson Building, Denver. Raymond B. Kelly, Jr., who joined the company last January, has been made division manager.

Kelly, before joining the company, had been exploitation engineer for Richardson & Bass at Fort Worth since 1947. Previously he had been with Humble Oil & Refining Co. He is a graduate of Princeton University, and served as lieutenant (j.g.) in the navy from 1943 to 1946.

Two of the newly acquired rigs have been assigned to the new Rocky Mountain division for use in the Denver-Julesburg basin. One of these, an Ideco H-35, is rigged up for 4,500 to 6,000-ft. drilling. The other, Model H-525, will handle drilling in the 5,500 to 8,000-ft. range.

Another new H-525 rig is going to the company's North Dakota division for medium-depth drilling. It is the second rig for that division, managed by James A. Burhans, headquartering in the Professional Building, Bismarck.

The other three new rigs, all of the H-35 type, will replace three H-30 rigs operating in the Illinois division. The company has two other rigs working in this area.

Counting two medium-depth rigs operating in Oklahoma by Calvert Drilling Co., a subsidiary, managed by H. K. Calvert, Oklahoma City, the company will have 11 rigs running in four areas.

Blackie Drilling Co. is moving a heavy rig to a wildcat location on Alligator Point, on the shore of Lake Borgne, near the Orleans-St. Bernard Parish line, Louisiana, where it will drill a 10,000-ft. test for George S. Engle.

Southern Six Drilling Co. has contracted with Atlantic Refining Co. for a 10,000-ft. wildcat test to be drilled in Breton Sound, off the coast of Plaquemines Parish, Louisiana. Location is in Block 16, on State Lease 1260.

Kern-Trimble Drilling Co., Magnolia, Ark., is handling contract for A-1 Sturgis, C SE SE 12-17s-27w, proposed Hill sand wildcat 1¼ miles southeast of Fouke field in Miller County, southwestern Arkansas. The McAlester Fuel

Bill Covington (top left) is tool pusher on the heavy-duty rig Warren-Burdett, Inc., Houston, has been operating under contract for Sun Oil Co. in the Cow Pen Creek area, northeast of De Quincy, in southern Beauregard Parish, Coastal Louisiana. Others with him in the picture are: Jack Lagrone (top right), driller; and (bottom row, left to right) Thurston Moses, Cecil Carpenter, and Austin Hebert, crewmen; E. V. Frames, Continental Supply Co.; and J. B. Robbitt, crewman. Picture, by courtesy of Continental Supply Co., was taken on Sun's 1 Long Bell, now being completed as a gas-condensate producer with total depth of 9,249 ft.

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Co. venture will seek production to about 5,500 ft. The wildcat is located about 2½ miles northeast of Fouke townsite.

El Dorado Pipe & Supply Co., El Dorado, Ark., is contractor for Goodwin Abbott, and Associates at their 1 Goodwin, C NE SE SE 16-16s-15w, proposed Travis Peak wildcat 1⅝ miles southwest of production from that horizon at Smackover field in Union County, Arkansas. Hole will go to 3,200 ft., sufficient to test Travis Peak sands.

Delta Drilling Co., Tyler, Tex., holds contract for a 9,300-ft. test of the McFearin sands for Lion Oil Co. at 1 Lomax, 28-20n-4w, new test on southwest edge of Lincoln Parish, Louisiana's Hico-Knowles field, North Central Louisiana.

MacGregor Drilling Co., El Dorado, Ark., will handle contract for a 3,600-ft. operation for Atkins & Pannell Drilling Co. at 1 Reynolds-Gammill Lumber Co., C NW SE NE 12-16s-15w, Union County, south-central Arkansas. The wildcat is drilling as a proposed Travis Peak wildcat 1¼ miles east of production from that horizon in Smackover field.

Tri-State Drilling Co., Laurel, Miss., will hold contract and move a new rig on location for a Hosston test which is planned for a depth of 14,500 ft. or 400 ft. into the top of the Hosston formation for Panuco Oil Leases, Inc. 1 W. B. Purser et al., C NW SE 15-1n-3w, deep wildcat in Copiah County, Mississippi. The wildcat is located 6½ miles northwest of Hazlehurst.

Como Drilling Co., Natchez, is handling contract for an 8,000-ft. production-seeker for E. C. Wentworth. The E. C. Wentworth and Como Drilling Co. 1 Edwards is located in 31-3n-4e, 1½ miles northwest of Marksville field in Avoyelles Parish, Central Louisiana. The Wilcox test is 1½ miles southeast of Moncla. Nearest control is furnished by wells on the northwest edge of Marksville field, a Wilcox sand producer.

Marshall R. Young will handle contract for a 12,300-ft. test for Vaughey & Vaughey at 1 Edwards-Abrams Unit, NW SW 26-10n-13w, on the Jasper County, Mississippi, side of Soso field. This test is an east offset to Gulf Refining Co. 1 Edwards-Taylor. Young will handle contract for Humble Oil & Refining Co. 1 S. S. King et al., 27-10n-13w, also slated to a depth of 12,300 ft. The wildcats are part of a deep Rodessa program.

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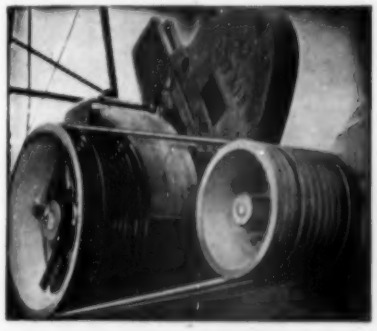

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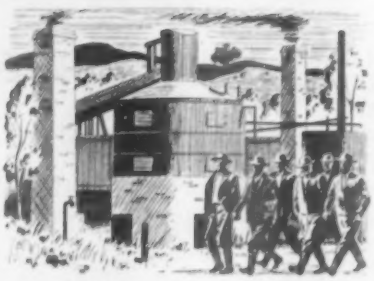
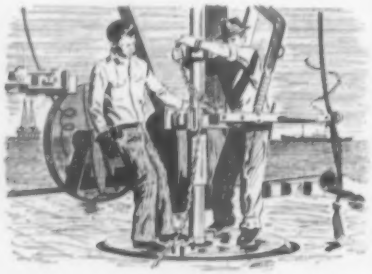
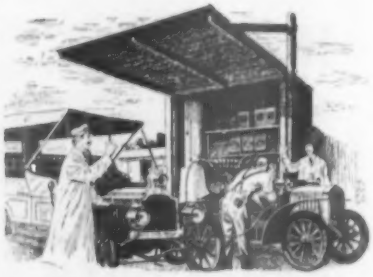


Gasoline was a waste product in Standard's first refinery of 1879, but it's king today. We've developed fuels that made better engines possible, used research tools like the chassis dynamometer (below) to bring you today's top gasolines.



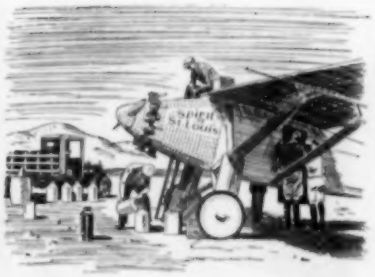
Before horses gave way to horsepower, Standard's wagons of the '80's brought only kerosene, harness oil and axle grease to Western farms. Now our insecticides, weed-killers, fertilizers help increase crop yields and add to your food supply.

First steel tanker in the Pacific, Standard's *SS George Loomis* back in 1888 began helping us put oil where you need it. Today 26 tankers, 3,748 miles of pipe line, thousands of tank trucks serve your oil needs wherever you are in the West, Alaska, Hawaii.

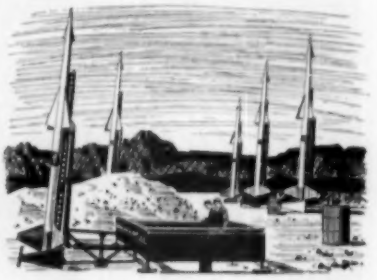


World's first gas station was opened by Standard in 1907 at Seattle, Washington. Since then, we've pioneered the car care you enjoy now—windshield cleaning, tire, battery, lubrication service, even "Chevron-matic" credit cards to save you time.

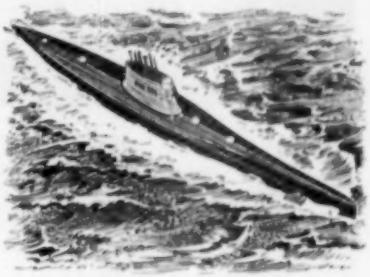
First oil industry 8-hour day was introduced by Standard in 1917. This was a major step in our employee relations programs which include health, pension, insurance benefits and a stock purchase plan—95% of eligible employees own Company stock.



On Lindbergh's trans-Atlantic flight in 1927, we fueled "The Spirit of St. Louis." Now, safer airliners, faster military planes mark aviation progress which Standard's research has served. Now we're making fuels for tomorrow's jets and rockets.

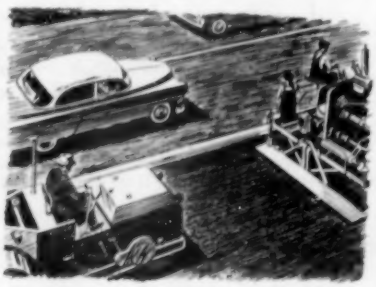


New power for transportation and industry was born in 1935 when Standard's first compounded diesel lubricating oil made high-speed diesel engines a practical reality. Now our scientists are working on lubricants for the first atomic submarine.



Making housework easier, Standard made detergents available for "soapless soaps" in 1946. Later we produced the basic ingredients for wrinkle-proof clothing for men and women, adding again to the more than 1100 products we make from oil.

We pioneered peace-time use of atomic energy. In 1950, using radioactive piston rings, Standard measured engine wear as it occurs, used this research to develop better motor oils, including a new oil so superior it can boost gas mileage up to 15%.



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What lies ahead? If the past is any clue, oil will be saving you more work and money, improving your transportation and putting more luxury in your living. And Standard will continue to play a big part in this progress as we follow our 75-year tradition of planning ahead to serve you and the nation better.

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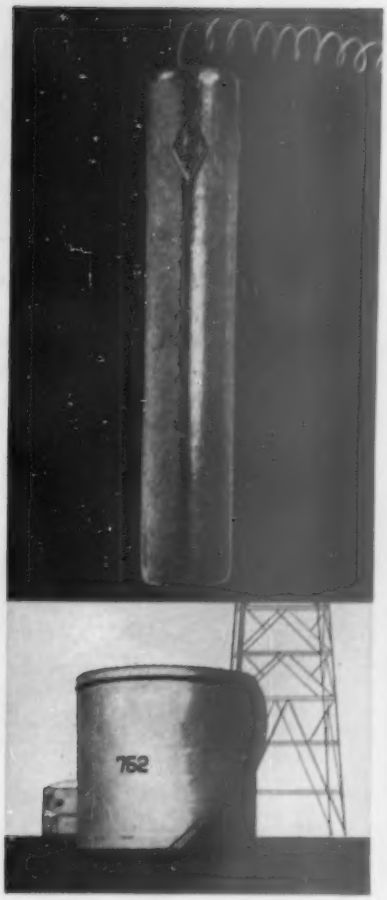

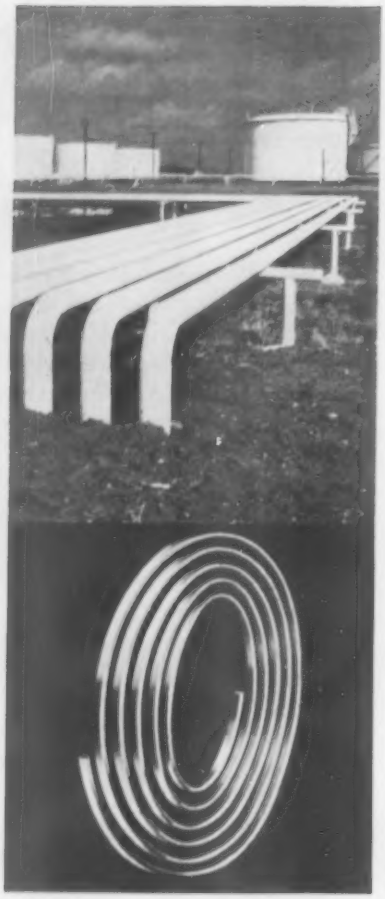

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Forget about cathodic protection repair bills —install high purity cast anodes and labor-saving ribbon anodes

Once installed, Dow magnesium anodes will never let you down. Throughout their entire life span they never stop providing *dependable*, low-cost corrosion control.

When you standardize on magnesium anodes you can forget about power failures and costly repair bills caused by storms, rodent attack on power leads, and dried-out ground beds. Magnesium anodes provide their own current for continuous cathodic protection.

And now the cost of cathodic protection is sharply reduced, thanks to the new *high purity* of Dow cast anodes. These new anodes last far longer and give you more ampere hours of protection.

Whether underground or marine; whether you require only "hot spot" protection or over-all coverage, you will find there's a Dow magnesium anode designed to solve your particular corrosion problem. For the complete story write THE DOW CHEMICAL COMPANY, Midland, Mich., MA 312J.

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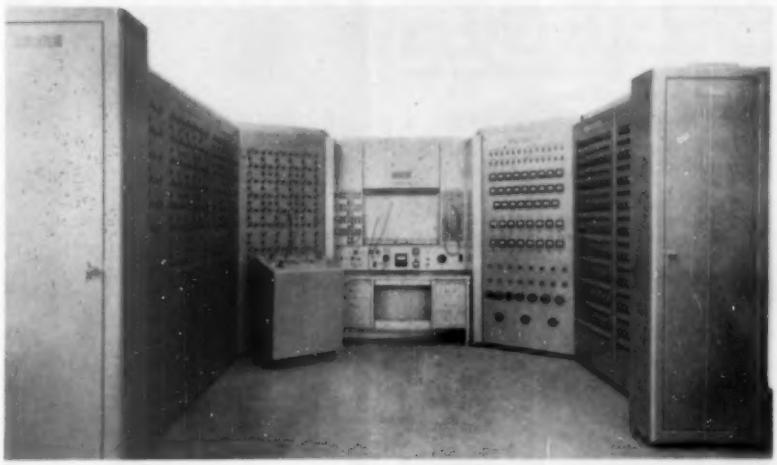
Pipeline Patrol



PIPELINE ANALYZER used for the solution of fluid-flow problems. Complex pipeline networks are duplicated electrically and the related pressures and flow rates are read directly from meters in circuits.

Network analyzer solves flow problems

A NETWORK analyzer has recently been developed for the rapid solution of problems involving fluid flow and friction losses in complex pipeline networks. This analyzer, which is an electrical analog computer, may be used to study high and low-pressure gas systems, oil pipeline networks, or any other system involving fluid flow. The important advantage of the instrument is that it solves easily and rapidly complicated flow problems whose solutions might never be attempted by laborious, hand-calculation methods.

Typical results of these studies include the determination of proper pipe size for economy and performance, best location for proposed pipelines from a flow standpoint, and the effects on flow of various locations of storage reservoirs. Also determinable from use of the analyzer are the proper ratings of pumps and compressors, the constant pressure contours in a distribution network, and the evaluation of pressure variations caused by unusually high discharge rates.

Each analyzer is built to meet the specific needs of the purchasing company but can be modified to fit any system. Its design allows the addition or removal of circuits as pipeline connections expand or change.

Tungsten-filament nonlinear resistors are used in the instrument as the electrical analogue to sections of pipeline. The resistors are made in a series of about 200 ratings to cover a wide range of pipeline diameters. Their interconnection in parallel and series arrangements forms the network to be studied. In the circuitry, the voltage drop across these nonlinear resistors varies as the 1.85 power of the current flowing through them. This affords an excellent analogy to the friction head loss in a pipeline with rate of flow.

Direct Current Used

Direct-current sources, which may be inserted at any point, furnish the power for the system. Discharge rates are established by load circuits which may be connected to any network terminal. These rates may be held constant, if so desired, by the use of a constant-current device. An ammeter and a vernier rheostat, included in each load circuit, are used for fine load adjustments. Differences in static heads between points in the system are accounted for automatically by the addition or substraction of voltage at the junction in question.

Indicating voltmeters and ammeters can be switched to any part of the assimilated pipeline system to give readings of pressure and flow. These instruments are calibrated directly in fluid-flow units.

The time involved in making a system analysis is dependent upon the experience of the operator and the number of system connections. Setting up of a pipeline network on the analyzer

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takes up most of the time and after this is done, problems may be solved in a comparatively short time. For example, a problem on a network having 70 pipelines, 15 loads, and 5 sources was solved in 1 day, including setup time. Succeeding analysis, using the same network but with different flow rates, took only 2 hours.

This analyzer, invented by Dr. M. S. McIlroy, is manufactured by Standard Electric Time Co., of Springfield, Mass.

New Use for Pipeline

SUCCESSFUL PULL is completed as grease-coated pipe emerges at far end of line. Note two-way communication equipment that made the job easier.

RECENTLY the engineering department of Shell Oil Co.'s Wilmington refinery was confronted with the problem of replacing approximately 1,350 ft. of the 14-in. gas line that delivers fuel from the Signal Hill absorption plant.

The problem was complicated by the fact that the old line ran under several refinery buildings, across the parking lot, and in front of the main entrance. After due consideration it was decided to pull 10-in. pipe through the old line without disturbing the latter.

First, a scraper was used to clean the old line and then a 1⅝-in. cable was pulled through and attached to the 10-in. pipe. The new pipe had been welded into 400-ft. sections and air tested before the pulling operation started. Each section was given a heavy coat of grease and pulled into the old line before the next section was tied in.

Safety during welding operations was insured by the use of an electronic gas sniffer to sense the presence of combustible mixtures. A two-way communication system was also employed to make work more safe and efficient. (Reprinted from the Grapevine).

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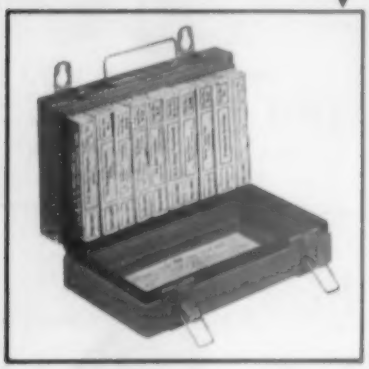

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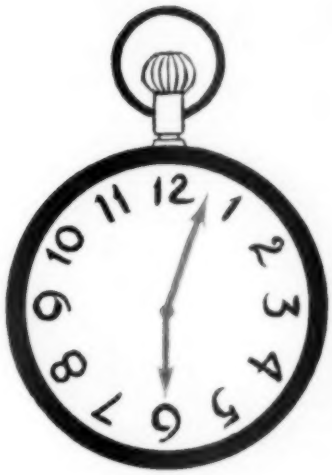

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The fittings that revolutionized pipe welding . . .

In the year 1931 Taylor Forge gave industry its *first real line* of seamless, butt-welding pipe fittings. We say it was the first *real* line because it was the first to include not only long and short radius ells, but also full branch and reducing tees, concentric and eccentric reducers, stub ends, caps and welding neck flanges.

This was a fully planned development. Many years before Taylor Forge had foreseen the future of the butt-welding fitting . . . had realized that pipe welding could not go beyond its then crude stage until pipe users were given *all* the fittings necessary to make up complete piping systems.

So Taylor Forge went to work on this and after long research and development came out with the full line that became the inspiration of modern pipe welding.

Naturally the organization that started ahead has kept ahead . . . in design, in quality, in breadth of line. That is why so many men who have followed the development of the WeldELL line, refuse to consider any other kind of welding fittings.

T F

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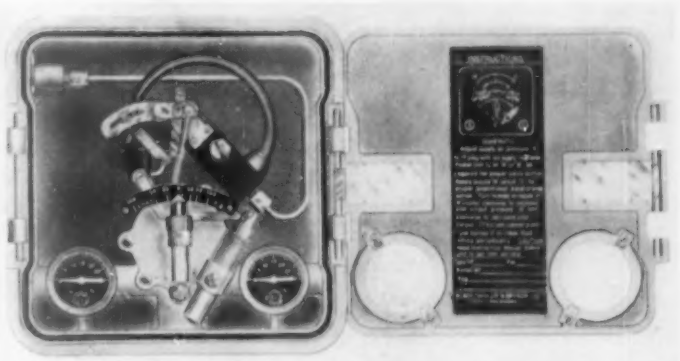
. . . What's New in Equipment?

Use the handy Time-Saver Cards ✔✔✔ to obtain additional information on these items

by Dan B. Miller



Controller Designed for Flexibility

The Climax Type 1440 Pressure Controller (nonrecording) is designed to handle both positive and negative pressures from high vacuum to any amount of pressure desired. Bourdon-tube actuated, the pressure controller is adaptable to operations requiring highest sensitivity or where throttling ranges are necessary to dampen sensitivity.

The controller overcomes cyclic or hunting action where conditions make lined-out pressure control difficult. It is adaptable to vacuum relief control, reduced pressure control, fluid pressure control, pump-discharge pressure control, boiler-steam pressure control, off-and-on-control, and snap action where the two limits may each be set at any desired pressure up to 25 per cent of Bourdon tube rating. Range is: vacuum to 10,000 lb. working pressure. *Black, Sivalls & Bryson, Inc.*

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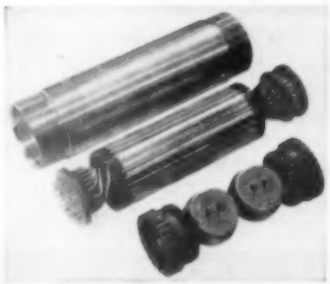

Marine Geophone Offers Highest Sensitivity

The S-16-WC-2 dual detector marine geophone offers highest sensitivity, and in applications where less sensitivity is required, the S-16-WC-1 single detector model can be used.

The hermetically sealed detectors are gimbal-mounted in special bearings. Good electrical connections are assured by the use of spring-loaded, continuous wipers which maintain contact through 360 degree rotation of the detector assembly. The contact points are made of precious metal to avoid corrosion and wear problems.

Cable conductors are carried in milled grooves in the inner assembly, and thus are protected from abrasion and the possibility of shorting. The outer case is a seamless bronze sleeve with threaded ends to accept the cable bell housing. Complete assemblies have been pressure tested to a depth of 250 ft. in salt water. *Southwestern Industrial Electronics, Inc.*

Check No. 2 On The Time Saver Card

●

Super Mix Is Designed for High Pressure, Temperature

Super Mix is an oil-base drilling fluid for use under high pressures and temperatures. It can be weighted to extremely high weights while maintaining low viscosity. Tests have been run for periods of 4 weeks under high pressures and at temperatures up to 400° F., yet properties have been unaffected.

It is particularly suited for drilling and completion operations in deep, hot holes and for drilling through heaving shales and other troublesome formations. During a recent test, Super Mix was weighted to 17.0 lb. per gal., 127.5 lb. per cu. ft. with a viscosity of 69 seconds A.P.I. at 120° F. The mud was in use for 6 weeks and total treating cost was less than $300.

Super Mix is also being used as a packer fluid, as a high-weighted fluid in the annulus above production packers in high-pressure wells. It does not settle, disintegrate, solidify, or deteriorate by standing idle for long periods. When used as a perforating fluid, Super Mix withstands the excessive heat and force of the charge and does not bake into a hard plug. It dissolves in crude oil when the well comes on production, thus assuring a high return of permeability. *Oil Base, Inc.*

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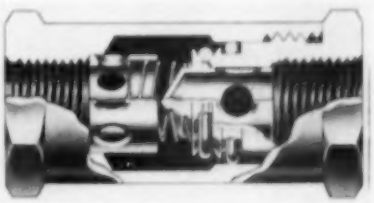

Check Valve Prevents Fluid Loss on Crossconnections

The Circle Seal check valve, now available in 1½ and 2-in. sizes, in addition to the smaller sizes, provides safe operation of systems such as oxygen-

GLASS GUN INCREASED PRODUCTION FROM SHOW TO 960 BOPD!

Two previous perforating jobs with conventional jet charges had failed to open flow channels for the oil

Production from a well in a conglomerate formation still remained negligible after two attempts to perforate with conventional jet charges. It was thought that the producing section had been mudded off when the well was drilled in.

In another effort to bring in the well, the operator decided to perforate with the Dowell Glass Gun, using GG-4 charges. Within a few hours after Dowell engineers did the job, the well was producing at the rate of 960 barrels of oil per day!

Drum tests through casing into cement and sand demonstrate the extra value you get in perforating, when you use Dowell Perfojet Service with the Glass Gun. In such tests, Glass Gun charges have shown larger hole sizes and twice the penetration of conventional charges.

Four sizes of charges permit Glass Guns to be tailor-made to fit a wide variety of shooting patterns and hole sizes. Charges can be set to fire in single, double, or triple vertical rows, and at angles up to 30° from horizontal. Because it is self-destroying, there is no danger of hanging the gun in the casing after firing. The well is left junk-free.

Dowell Electric Pilot equipment is used in Glass Gun perforating. These sensitive recording instruments give the engineers fingertip control over the entire operation. Dowell's active safety program is planned to protect both personnel and well equipment. And Dowell research is aimed to give you more profitable perforating jobs.

For more information about how Dowell Glass Guns can help you, contact your nearest Dowell Station. Or, if you prefer, write directly to Dowell Incorporated, Tulsa 1, Oklahoma, Department E-11.

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propane, preventing unintentional mixing of the two gases in supply lines. Safety is also assured in operation of air-actuated devices in the event of failure or reduction of air or vacuum supply.

In processing industries these valves find use in many circuits where two systems are crossconnected, preventing escape of high-pressure fluids into low-pressure lines. The advantage is evident, for example, in injection lines whereby fluids are pumped into pressurized processing equipment. The zero leakage of the valve positively prevents the mixture of materials in the lines and the dependable operation controls or prevents reversal of flow under any circumstances. *James-Pond-Clark.*

Check No. 4 On The Time Saver Card

●

New Model Completes Taco Circulator Line

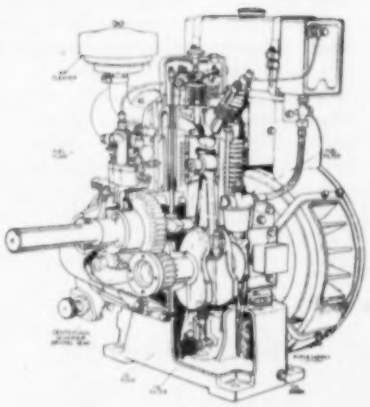
With the addition of this new HC25 2½-in. circulator, Taco offers a complete line of horizontal circulators from ¾-in. up to and including 4 sizes of 3-in. units. All sizes are now available in bronze as well as cast iron. *Taco Heaters, Inc.*

Check No. 5 On The Time Saver Card

●

Lightweight Diesel Is Air-Cooled

The Petter PAZ1 is a single cylinder, four-stroke cycle, air-cooled diesel developing 2½ hp. at 1,500 r.p.m. continuous rating. The engine has a bore and stroke of 3-in., and with a b.m.e.p. of 62 lb. per sq. in., and a maximum mean piston speed of 750 ft. per



minute, produces a conservatively rated power unit.

The engine has a dry weight of 260 lb., and with air cooling is suitable for a wide range of power applications. The crankcase of cast iron is tunnel bored, the lower part of which forms the lubrication oil sump.

The crankshaft is carried by two steel-backed, thin-shell, precision-type flanged bearings. One of these bearings is pressed into the crankcase at the gear end, and the other is carried in a cast iron bearing housing bolted to the crankcase at the flywheel end. Crankshaft thrust is taken in either direction between the flange faces of the main bearings and the relative faces of the crankshaft.

The combustion chamber is formed by an offset hemispherical bowl in the crown of the aluminum-alloy piston. The top compression ring is chrome-plated to reduce cylinder bore wear. *Petter Diesel Engine Division, Brush Aboe, Inc.*

Check No. 6 On The Time Saver Card

●

Electronic Witch Features New Wiring Circuit

This new electronic pipe finder features greatly improved operational and over-all field performance for locating and tracing buried pipes, conduits, and metal objects. A completely new electronic circuit is used as well as new and more durable interior and exterior components.

The conventional-wound multiturn antenna loops and beat oscillator-type circuit have been eliminated. The new circuit is exceedingly stable for all field applications, and is insensitive to temperature changes and the shock and vibration of rugged every day field use. The "B" battery consumption is over 50 per cent less than that of the average of all currently produced instruments of a similar nature. To the consumer this means that the "B" batteries will last about three times as long between bat-

tery changes. The "A" batteries will last fully twice as long.

The Electronic Witch is much less sensitive to all types of outside interference, particularly that associated with overhead power lines. A new super sensitive fluid leak detector has been incorporated into the instrument, further increasing its field usability as an emergency leak detector. *Fisher Research Laboratory, Inc.*

Check No. 7 On The Time Saver Card

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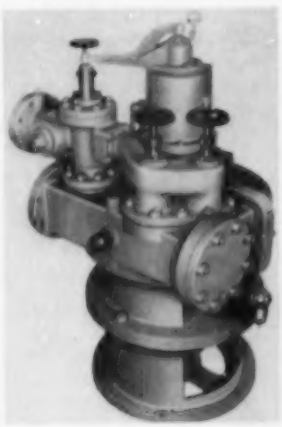


Vertical Turbines Have Increased Power

New vertical turbines have more power. A major change was the addition of a steam nozzle to all models. As a result Models DH-10V and DH-20V have 100 per cent more power than former one-nozzle counterparts. Model

DH-30V now has 3 steam nozzles and 50 per cent more power.

Two hand valves improve regulation of water rate at reduced loads. Improved packing boxes check steam pressure leakage and permit a higher working exhaust steam pressure.

For longer service the new turbines have a double-row ball bearing with greater thrust capacity. Overlapping labyrinth slinger on lower bearing prevents moisture seepage. An improved emergency trip mechanism has cylindrical guide to maintain alignment of trip valve stem in all positions.

In the DH design, high pressure steam does not come in contact with casing. All high pressure parts and joints are outside and visible to the operator. Maintenance is easy even for unskilled employes. *Dean Hill Pump Co.*

Check No. 8 On The Time Saver Card

●

Flexi-Trol Provides Plant Efficiency

Many business offices and industrial plants are using the new Flexi-Trol visual control board to see at a glance, all the facts in any situation. It is being used for production schedules, sales recorders and quotas, personnel analysis, management control and analysis, service schedules, inventory control, warehouse control, and organization charts.

Records maintained on the Flexi-Trol cannot be lost or misplaced. All persons concerned consult the same record. Deadlines, shortages, and overdue items are highlighted before they become serious. Standard board is 42 in. wide and 24 in. high and is accompanied by 1,000 cards used for posting data. A confidential model is supplied with hinged covers to close confidential records. *Methods Research Corp.*

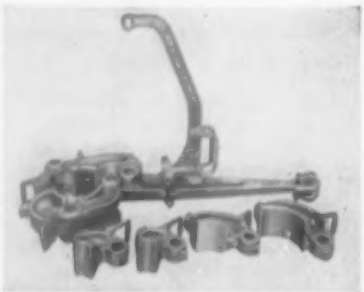
●

Check No. 9 On The Time Saver Card

New Tong Adds Safety in Breaking Tight Joints

This new Type H tong was designed to break out the largest and tightest drill collars or tool joints with maximum safety. It embodies all the features of other Web Wilson tongs, with such added features as 2-in.-diameter hinge pins; 30 per cent greater strength, with only 15 per cent increase in weight; and ring retainers at both ends of each 2-in. hinge pin to prevent any possible broken parts from falling out.

The strong Type H is readily balanced and is easily closed around or unlatched from the pipe. By changing



the lug jaw, each tong will handle all pipe sizes from 3½ to 11¾-in. *Web Wilson Oil Tools, Inc.*

Check No. 10 On The Time Saver Card

●

Shovel Crane Offers Both Portability and Capacity

This 1-yd. shovel-crane, the LS-98, has been designed to give industrial users the portability advantage of a ¾-yd. size and the output advantage of the heavier sizes.

The Speed-o-Matic control contributes to the machine's increased productivity. The power hydraulic control system provides faster working cycles and easy operation, and the power and stamina built into it are such that the machine can maintain its fast working cycles without undue wear.

Weighing approximately 53,000 lb. as a shovel, the LS-98 when loaded on a flat-bed trailer falls within the highway road limits prescribed by most states, without major dismantling. Also, the machine features foolproof power steering and two-speed travel gear as standard equipment. *Link Belt Speeder Corp.*

Check No. 11 On The Time Saver Card

●

Lab Viscometer Designed For Wide Application Field

The Fann Model 35-V-G meter is a small, multispeed, inexpensive, laboratory viscometer. Designed for exacting research on Newtonian fluids, pseudoplastics, and Bingham bodies, many features make it ideal for rapid determinations of viscosity, yield point, gel strength, and thixotropic studies.

Spindle speeds of 3, 6, 100, 200, 300, and 600 r.p.m. are obtained through a precision gear train driven by a 115-volt, 60-cycle synchronous motor. Speeds are selected and changed without stopping rotation. The motor is isolated from parts in contact with test fluid to prevent heat transfer.

It is ruggedly constructed for the hard service associated with testing of muds, slurries, emulsions, and similar materials. A stainless-steel sample cup with scribed line for proper filling is furnished. *Geophysical Machine Works.*

Check No. 12 On The Time Saver Card

●

They're NEW

- Bulletins
- Catalogs
- Brochures

for your copy, check ✓ ✓ the Time-Saver Cards.

Uninterrupted Continuous Standby Power. Model MG3AG 18 Micro-Power unit in capacities from 3 to 10 kw. are described in a 2-color 4-page brochure. Data includes installation and wiring diagrams and voltage and frequency charts. *United States Motors Corp.*

Check No. 13 On The Time Saver Card

●

Heat Transfer Equipment, a 16-page, multicolor brochure illustrates fabricating facilities of the plant, and a number of specialized processing vessels such as lean-oil-to-rich-oil exchangers, reboilers, high-pressure gas coolers and condensers, vacuum condensers, atmospheric gas coolers, internal U-bend bundles, and shell-and-tube high-pressure gas exchangers. *Engineers & Fabricators, Inc.*

Check No. 14 On The Time Saver Card

●

Automatic Bottom Hole Chemical Injector describes equipment designed to inject chemical for corrosion and scale inhibition at the bottom of the tubing strings in high pressure gas wells and flowing or gas-lift wells. Bottom hole temperature operates a bellows which, in turn, operates the chemical dump valve, permitting the flow of inhibitor. *Specialty Products Co.*

Check No. 15 On The Time Saver Card

●

Interflux Marine Finishes and Accessories. Bulletin 54 provides application information on a line of finishes that are compounded especially for painting surfaces subjected to corrosion and abrasion. The 61-page booklet also includes instructions on various jobs. *International Paint Co., Inc.*

Check No. 16 On The Time Saver Card

●

Flexible couplings. Engineering details and specification data on heavy-duty flexible couplings for power drives, are presented in a new 2-color, 20-page brochure just published. In addition to the company's products, the bulletin carries a horsepower-to-torque conversion table, a varying or pulsating-load conversion table, and on-the-job illustrations. *Lovejoy Flexible Coupling Co.*

Check No. 17 On The Time Saver Card

●

All-Steel Motoreducer, an eight-page foldout, suitable for looseleaf binding, illustrates a Motoreducer to fit every job. Line illustrations feature any position of output shaft, any output shaft connection, any type of motor, any modification, and mounting in any position. *The Falk Corp.*

Check No. 18 On The Time Saver Card

●

Alco Products Review. The spring issue of this quarterly magazine carries articles entitled "Cycle and Casing-Head Gas Processed at Seeligson Plant," and "Bay Refinery Unit Extracts Isobutylene" in addition to descriptions of Alco Type D high-pressure closures, and facilities for making nickel-plated pipe. *American Locomotive Co.*

Check No. 19 On The Time Saver Card

●

Price List GD-1 is a new data sheet covering the rental of the new Bariod Recording Gas Detector Units and a description of the service. The service is offered for use on wells whether or not they require the complete Baroid well logging service. *Baroid Sales Division, National Lead Co.*

Check No. 20 On The Time Saver Card

●

Catalyst Poisoning Reduced 90 Per Cent. This case history shows how the installation of a stainless-steel wire mesh demister pad in a vacuum tower supplying a substantial portion of the charge stock to several cracking units at General Petroleum Corp.'s Torrence refinery resulted in a 90 per cent reduction in catalyst poisoning. Included is a detailed description of tower operating conditions, mesh installation method, and a table comparing metals content before and after installation. *Otto H. York, Inc.*

Check No. 21 On The Time Saver Card

●

Well Servicing, Workover Catalog. The new 1954, 52-page catalog describes a complete line of well-servicing and workover units for the shallowest to deepest wells, and a new line of drilling rigs for drilling to 7,500 ft. *Franks Manufacturing Corp.*

Check No. 22 On The Time Saver Card

●

Blue Flag Glass-Fiber Pipe Wrap. New four-page brochure on underground pipe wrap describes the function of the bonded mat material in reinforcing enamel coatings which are applied to

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Exceptional non-galling and easy "break out" of drill pipe. Low friction moly-disulphide in high temperature silica grease! Use it on those extra tough jobs. JET-LUBE 21 does a remarkable job at low cost. Batch controlled. Fully guaranteed.

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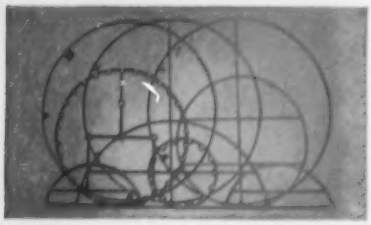

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Here is a dependable source for gaskets for heat exchangers. These gaskets can be made in any size or shape as needed—cut from solid metal, sheet-packing; also double jacket type.

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underground oil and gas transmission lines to prevent corrosion. Inert glass fiber developed for exclusive use in Blue Flag pipe wrap is stressed, pointing out its resistance to the deteriorating effects of soil chemicals. Well illustrated, the brochure contains interesting test data on penetration ratios for reinforced and unreinforced enamels. *Glass Fibers, Inc.*

Check No. 23 On The Time Saver Card

●

Birkmyre's Cloth. This well-illustrated, 20-page booklet describes the applications for a material specifically woven for weather-resisting qualities and reliability under most testing climatic conditions. Tarpaulins, tents, protective coverings for structures, and transport coverings are all illustrated. *The Gourock Ropework Co., Ltd.*

Check No. 24 On The Time Saver Card

●

Sargent Rodless Pumps. This hydraulically operated down-hole pumping unit consists essentially of a standard production pump coupled to and driven by a hydraulic engine valve. The engine valve is energized by crude oil under pressure which is furnished by a reciprocating pump located at the surface. The brochure includes pressure-volume data, a schematic drawing and flow diagram, and a series of case histories classified by fields and depths. *Sargent Engineering Corp.*

Check No. 25 On The Time Saver Card

●

Transhield, an illustrated four-page folder provides a handy reference piece for pipeline contractors and owners. The folder explains how this new lightweight reinforced-asbestos pipeline felt is made, shows it being applied, suggests where and how it can be used to advantage, and includes charts listing essential data. *Johns-Manville.*

Check No. 26 On The Time Saver Card

●

Vickers Heavy-Duty, Longstroke, Hydraulic Oil-Well Pumping Units. A new eight-page, three-color catalog, 53-51, describes two models of self-contained mechanisms that actuate conventional sucker-rod string and surface pumps at constant rate with shockless controlled reversals. Dimensional drawings and suggested foundation layouts are given for two 125-hp. units. Both models have maximum polished-rod load ratings of 35,000 lb. and maximum counterbalance load ratings of 27,500 lb. *Vickers, Inc.*

Check No. 27 On The Time Saver Card

●

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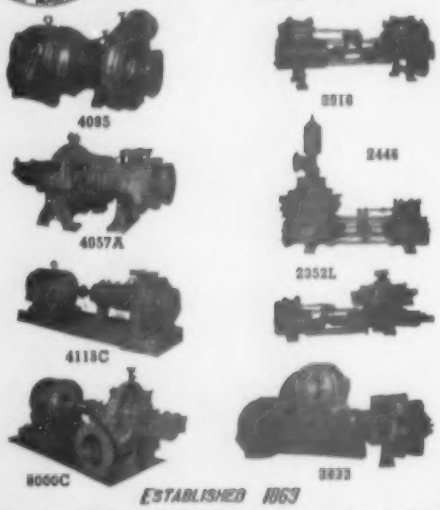

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CHLORAX Spray Powder: Eliminates the fire hazard of weeds and grass. Ideal for use around storage tanks, pipe lines, refineries, etc. Has a residual effect that discourages regrowth. Is non-inflammable and non-posionous. Can be applied dry as a water-mixed spray.

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ATLAS "A": Very economical weed and grass killer. Used for the same purposes as Chlorax. Comes in liquid form . . . easy to mix and apply. Non-inflammable and non-explosive.

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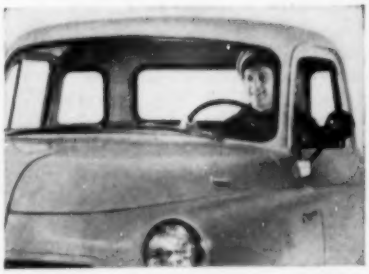
"Our new Dodge truck is a better deal for me and for my boss, too!"

Our new Dodge "*Job-Rated*" trucks have proved a better deal in handling ease, visibility, comfort and power. You, too, can save time and money, work and effort with these great new trucks. Find out today why Dodge means a better deal all around!

YOU GET—A Better Deal In Steering! Sharp 39° turning angle and short wheelbase design make Dodge the sharpest turning trucks on the road. That saves you *time!*



YOU GET—A Better Deal In Seeing! Big 951 sq. in. windshield of Dodge cab is largest of any popular truck. All-around visibility is tops, too, for safer driving.

YOU GET—A Better Deal In Sitting! The 16-inch-high Dodge seat is deep and comfortable enough to be in your living room! Plus easy-to-reach controls and dispatch box.

YOU GET—A Better Deal In Power! You save on maintenance because every Dodge engine . . . V-8 or Six . . . has such long-life features as exhaust valve seat inserts, chrome-plated top piston rings and positive-pressure lubrication.

New Dodge trucks give A BETTER DEAL FOR THE MAN AT THE WHEEL—and a better deal for the man who pays the bills. Test-drive and learn how a Dodge makes driving easier and does more work in less time. Give your Dodge dealer a call. He'll be glad to show you.

DODGE

"Job-Rated" TRUCKS

TUNE IN: "Break the Bank," Sunday TV—"The Roy Rogers Show," Thursday radio—"Make Room for Daddy," Tuesday TV.

EQUIPMENT MEN . . . in the News

McKinney New President of National Supply

Arthur W. McKinney, who is widely known in the oil-field supply industry, has been elected president of The National Supply Co., manufacturer and distributor of oil-field machinery and equipment.

McKinney, who started with the company as a salesman in 1920, has served as executive vice president since 1948. He was elected to the presidency at a meeting of the board of directors in Pittsburgh on April 23, 1954.

In his new position, McKinney succeeds Alexander E. Walker, who relinquished the presidency. At the meeting, Walker was reelected chairman of the board and chief executive officer of the company.

McKinney is a graduate of Allegheny College, Meadville, Pa., in the class of 1918, and served as a lieutenant in the U. S. Signal Corps during World War I.

Starting with National Supply following his discharge from the Army, McKinney demonstrated a native ability to make friends and to sell the machinery and equipment used in drilling wells and producing oil. He won promotion to assistant manager of sales in 1929, manager of sales in 1934, general manager of sales in 1938, and vice president and general manager of sales in 1940.

A. W. McKINNEY

In his capacity as executive vice president, McKinney spent much of his time away from his Pittsburgh headquarters, checking the company's sales operations in the field and also calling on many of the customers whom he numbered as personal friends.

National Supply has its general offices in Gateway Center, Pittsburgh. It has six plants and is building a seventh. The company operates more than 100 supply stores throughout the oil country of the United States and Canada, and also has sales offices in principal cities. Sales in 1953, which reached an all-time high, exceeded $237,000,000.

McKinney is serving his second term as president of the Diesel Engine Manufacturers Association. He is a former president of the Petroleum Equipment Suppliers Association. In addition to serving as a director of National Supply, he is a director of Oil Well Engineering Co., Ltd., an English firm that is half owned by National Supply. He is a director of the Ohio Citizen Trust Co., Toledo.

During World War II, McKinney served as a member of the Industry Advisory Committee, Petroleum Administration for War, and of the Materials Committee, Petroleum Industry War Council.

Walker had served as president of National Supply since 1940. Previously he was executive president of Pittsburgh Steel Co.

Lane-Wells to Expand Well Surveys Facilities

Plans for the expansion of Well Surveys, Inc., Tulsa, pioneers in research and development in the field of radioactivity well logging, have been revealed by Lane-Wells Co. with the purchase of the remaining 50 per cent of Well Surveys' capital stock from Socony-Vacuum Oil Co. Lane-Wells has owned 50 per cent of the research firm stock since 1950 and since 1940 has been licensed to use methods and equipment developed by W.S.I.

Rodney S. Durkee, president of Lane-Wells Co., Lane-Wells Canadian Co., and Petro-Tech Service Co. of Venezuela, has been elected president of Well Surveys. Dr. John H. Buck, formerly associate director of a major project for Carbide & Chemicals Co., operators of Oak Ridge National Laboratory at Oak Ridge, Tenn., for the past 3 years, and previously supervisor of the physics division, Socony-Vacuum Research Laboratories, has been named vice president and technical director, and will be in charge of operations in the Tulsa facilities. D. W. Loots and Robert K. Schumacher have been named assistant treasurer and assistant secretary respectively and will be stationed in Tulsa. Other officers are Russell M. Otis and Morton T. Higgs, vice presidents, D. S. Jeppson, vice president and treasurer; and W. A. Miller, secretary and assistant treasurer, all of whom are executives with Lane-Wells.

R. S. DURKEE

JOHN H. BUCK

Magnet Cove Names Byerly Assistant Sales Manager

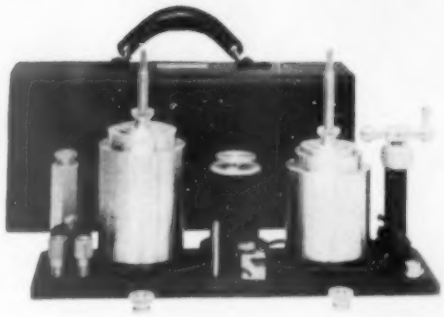
K. L. Byerly, Jr., has recently been appointed assistant general sales manager for Magnet Cove Barium Corp., Houston, according to Willard M. Johnson, president of Magcobar.

Prior to his promotion, Byerly was

Nickles Machine Continue Expansion

Nickles Machine Corp., Ponca City, Okla., has recently completed a major expansion and has started to add 4,000 more square feet. Founded in 1930 by C. A. Nickles, the company has grown steadily as a manufacturer of replacement parts and repair service on stationary diesels, gas-engine compressors, and pumping equipment. Sales representatives are located in Houston and Odessa. E. C. Nickles, son of the founder, is now general manager.

R. S. PORTABLE DEAD WEIGHT TESTER



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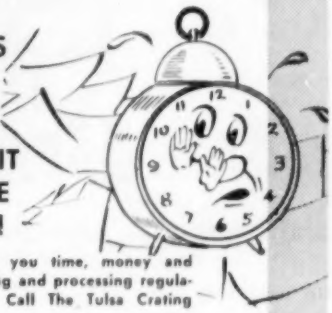

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Kinzbach Polished Rod Stuffing Boxes are plastic packed, have a floating, self-aligning gland and hold positive seals under the toughest conditions. Packing may be added and seal tightened easily without shutting in the well. Available in all popular sizes of polished rods.

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K. L. BYERLY, JR.

C. H. SYDOW, JR.

manager of the company's Gulf Coast division in Houston. He has been with Magcobar since 1948 and was formerly district manager for the company at Great Bend, Kans., and Sulphur, La.

Charles H. Sydow, Jr., has been named to replace Byerly as Texas Gulf Coast division manager. Sydow joined Magcobar in 1947 as a field service engineer, was later made district manager at Shreveport, La., and most recently was division sales manager in the company's Gulf Coast division.

Garrick Reelected Cherokee President

David A. Garrick was reelected president of Cherokee Laboratories, Inc., Tulsa, at the second annual stockholders' meeting. Robert D. Denny was reelected secretary-treasurer.

Cherokee Laboratories was organized in 1952 to manufacture and distribute, under license from Stanolind Oil & Gas Co., a new lost-circulation control material developed by Stanolind's research laboratory. The product, known as Tuf-Plug, is made of processed walnut shells. During 1953, Cherokee secured three new licenses from Stanolind; Tem Plug, an oil-soluble lost-circulation material; Cavern Plug, prism-shaped blocks of weighted cement designed to form barriers against lost circulation in large cavities; and Tuf Prop, a propping agent used in hydraulic fracturing operations.

D. A. GARRICK

R. D. DENNY

Cherokee maintains sales offices in New Orleans, Midland, Oklahoma City, Hobbs, N. M., and Casper, Wyo., and has distributors in Canada, and South America.

Hays to Represent Wheland In Gulf Coast Area

Cecil W. Hays has been appointed by The Wheland Co., Chattanooga, Tenn., as sales representative for its line of slush pumps, swivels, traveling blocks, and draw works in the Texas Gulf Coast area.

Before joining Wheland, Hays was sales representative for Lee C. Moore Corp. for 7 years. He had completed a 6-week training program in Wheland's Chattanooga plant prior to assuming his duties in the field.

Deco Balanced Power Slip Purchased by Web Wilson

Manufacture and sale of the power slip previously manufactured by DeLaney Co., Houston, have been taken over by Web Wilson Oil Tools, Inc. The product will now be sold under the name, Web Wilson Balanced Power Slip, and is recommended for use on tubing, drill pipe, and casing up to 7 in. in diameter.

Field warehouse stocks of all replacement parts will be carried for the present owners of this power slip; and parts to be manufactured by Web Wil-

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For the past four years we have been helping to extend these lifelines by shipping more than 24,000 carloads of Basalt-Kaiser Steel pipe to major projects throughout the country. This is enough to build a pipe line from Juneau, Alaska to The Panama Canal.

All of this steel pipe has been delivered *on time.*

This dependable delivery—plus *uniform quality, wide range of sizes,* and *prompt service*—is another reason why experienced pipeline companies know they can rely on Kaiser Steel.

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KAISER STEEL PIPE SPECIFICATIONS • All pipe manufactured to latest A.S.T.M. and A.P.I. specifications

Type	Diameter	Length	Wall Thickness	Shipping Point
Continuous Weld—Threaded and Coupled	½" to 4" nominal I.D.	Uniform 21'	Standard	Fontana, Calif.
Continuous Weld—Plain End	2⅜" to 4½" O.D.	Up to 40'	Standard	Fontana, Calif.
Electric Resistance and Fusion Weld—Plain End	14" to 18" O.D.	Up to 40'	.250" to .500"	Napa, Calif.—Basalt-Kaiser
Electric Resistance Weld—Plain End	5⅝" to 12¾" O.D.	Up to 55'	.188" to .375"	Fontana, Calif.
Electric Fusion Weld—Expanded—Plain End	20" to 30" O.D.	Up to 40'	.250" to .500"	Napa, Calif.—Basalt-Kaiser

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PHILLIPS PIPE LINE COMPANY uses EXCEL-SO separators ahead of desiccant dehydrators to remove free water and protect desiccant bed.

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DIVISION OF FRAM CORP. ● BOX 3096 ● TULSA, OKLAHOMA

LIFT-O-KRANE is rough, tough and ever-willin'

*With this versatile LIFT-O-KRANE you can do the impossible . . . Use it as a Crane Truck, a Fork Lift Truck and/or as a Ram Truck.**

Silent Hoist heavy duty LIFT-O-KRANE is designed to make the most difficult job "all in the day's work." Take, for example, one of the 5 ton capacity LIFT-O-KRANES in daily duty at SUN OIL COMPANY, Marcus Hook (Pa.) Refinery. Here it is shown easily handling a bulky, unbalanced, heavy-to-handle accumulator tank. Its next job may be dragging lengths of pipe lines and locating them properly in ditches . . . then lifting and moving giant valves and heat exchangers and installing them in their proper place in the refinery lines. According to one Sun Oil executive, LIFT-O-KRANES lift and serve, day after day, with efficiency and dispatch, and *replace entirely any need for regular cranes.*

*3-IN-1 MACHINE: With integrated BOOM Attachment—handle Hook Loads. With RAM Attachment—handle Hollow-Center Loads. With its FORK Tines—handle Timber, Machinery, etc.

You, too, should investigate the tough, maintenance-free service of LIFT-O-KRANE Combination Machine . . . and LIFTRUK Heavy-Duty Fork Truck . . . in 5 - 7½ - 10 - 15 ton capacities. Send for Bulletin 77.

SILENT HOIST & CRANE CO.
Pioneers of Heavy Duty Materials Handling Equipment
844 63rd Street, Brooklyn 20, N. Y.

son will be interchangeable with parts now in use.

Link-Belt Names Two To Oil-Field Sales

Two oil-field sales representatives have been appointed by Link-Belt Co. to serve in the Mid-Continent fields.

C. H. WINTERS

A. E. SMITH

They are C. H. Winters who will headquarter in Oklahoma City, and A. E. Smith who covers the West Texas-New Mexico area from headquarters in Odessa, Tex.

Winters started with Link-Belt in 1923 at Indianapolis. Later he was made assistant production manager of the firm's Ewart plant in Indianapolis. For a number of years he has made his headquarters in Oklahoma City, first handling sales of oil-field products and later other equipment. Smith joined Link-Belt in 1946 and has since served in various functions at Dallas and Houston.

Midwestern Engine Shifts Butler to New Sales Post

BUFORD BUTLER

Buford Butler has been promoted to sales engineer for pipeline supplies and equipment in the Mid-Continent territory, according to O. E. Murrey, president of Midwestern Engine & Equipment Co., Tulsa. Butler has been with Midwestern since early 1950 and has had over 7 years of experience in the pipeline supply business. From 1950 to 1952 he was president of Continental Wyoming Co., a pipeline-equipment manufacturing firm.

Butler will handle the entire line of Midwestern pipe wrap products including: Corroglas underground pipe wrap, Glasfab, anodes, Glastape, and Glaskote. In addition he will be in a position to supply pipeline equipment and technical advice on wrapping problems.

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. . . if your plug valves have

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Lubricates the valve, automatically, every time it is opened and closed.

It will lubricate the valve 50 to 80 times before reservoir needs recharging, and this only takes a couple of minutes.

Ideal for frequently opened valves on such locations as LOADING RACKS, MANIFOLDS, LPG SYSTEMS.

It fits all lubricated plug valves.

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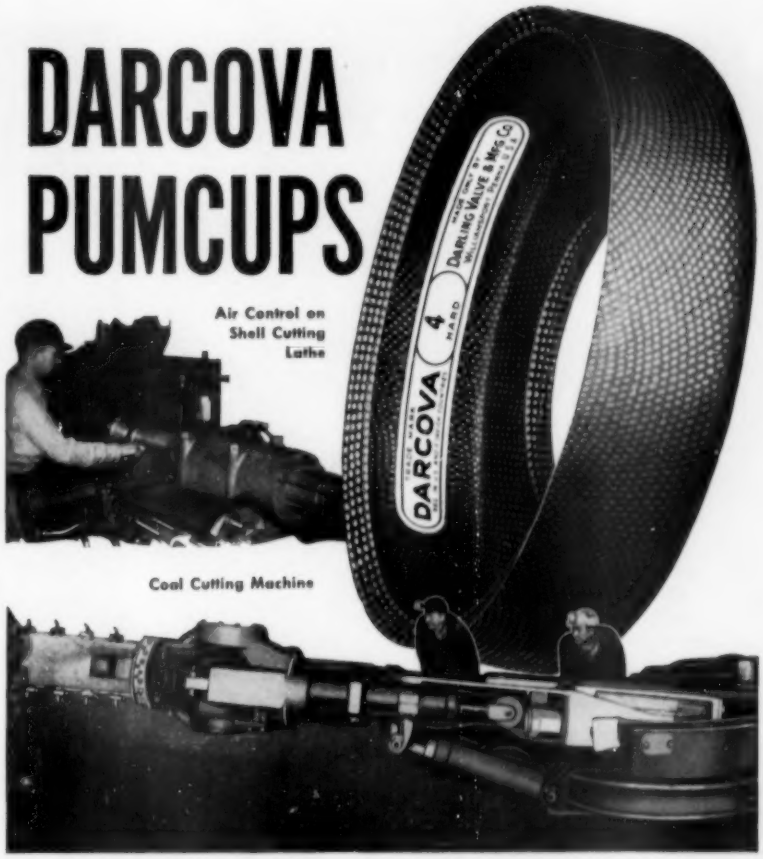

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EXPLORATION

The Present-Day Origin of Oil

by Frank J. Gardner

IS new oil being manufactured by Nature today? Seekers for the answer to the age-old question of "where did oil come from?" have at last done something about it. The results of some new studies have just been published by the American Association of Petroleum Geologists, and they possess significant import.

Past theories . . . Geology's guiding principle has always been the interpretation of the past in the light of today, and it is only logical that the same interpretation should apply to the riddle of the origin of oil. Many and varied theories have been advanced, one even postulating a cosmic beginning, but there was no agreement on the salient points of where oil came from and how it got where it is. The generally accepted theory, however, is that it results from the deposition of organic matter in marine or brackish waters.

A new idea . . . The original idea was that ages and ages of time, aided by heat, pressure, chemical activity, and great thicknesses of overlying rocks were required to generate oil from the organic matter that was deposited in the bottom of the ocean. In recent years, a new thinking has given rise to the belief that oil is forming anew every day, in every ocean. Why should the process ever have stopped? Reduced to that elementary question, the enigma had only one answer: if our theory of depositional origin is true, then we should be able to go out and take a look at it, in action.

Extensive work had been done on the question before. Research had been conducted by the A.A.P.G., the American Petroleum Institute, educational institutions, and oil companies; A.P.I. Project 4 had revealed no liquid hydrocarbons in recent sediments. But based on encouraging results with the isolation of hydrocarbons from kelp and algae, and the production of small amounts of gaseous hydrocarbons from organic extracts of Cuban marine mud, the new theory of present-day genesis took firmer hold, and the work recently done by Standard Oil Development Co.'s Esso laboratories seems to confirm it.

The groundwork . . . First, these researchers took an objective look at what they already knew, or believed: (1) that the first step in oil origin was the accumulation of organic material in sediments of marine or brackish water—this process they could actually observe; (2) that this material is transformed into hydrocarbons through bacterial, chemical, thermal, and compressive action—this they should also be able to observe; (3) that the hydrocarbons must "mature" in the direction of real petroleum—would they be able to observe actual globules of oil forming in recent sediments? They weren't sure.

Methods . . . Esso's men chose the Gulf of Mexico as a logical place to start the studies. Conditions of deposition there should be much the same as they were throughout Tertiary time; vast amounts of oil had been produced from Tertiary sediments, including some as recent as Pliocene. Question: why should oil not be forming there today? If it is, they should be able to observe it.

A systematic inch-by-inch examination of cores taken from the gulf floor to depths of 2,314 ft. below the floor was begun. Humble Oil & Refining Co. provided a complete core section from two wells off the Louisiana coast; other samples were taken from Laguna Madre, off Corpus Christi, Tex.; and to complete the environment picture, three sections of a core from Santa Cruz basin off the California coast were assembled.

The results . . . Some extremely interesting facts have come out of the Esso program.

It was observed that the amount of free hydrocarbons (paraffin - naphthene plus aromatic fractions) increase with depth of burial—from 7.5 per cent of extract at depth 3 to 4 ft. to 30.9 per cent at depth 102-103 ft.; further, that the percentage of asphaltic and complex organic matter decreased with depth from 92.5 to 69.1 per cent of extract at the same depth. From this, it might be concluded that organic content is being changed toward petroleum and becomes chemically more complex with depth.

To eliminate the possibility that these hydrocarbons might have been diffused upward from older rocks, the research party ran Carbon-14 analyses to determine the actual probable age of the sediments in years, and the resulting determination indicated the hydrocarbons to be indeed indigenous.

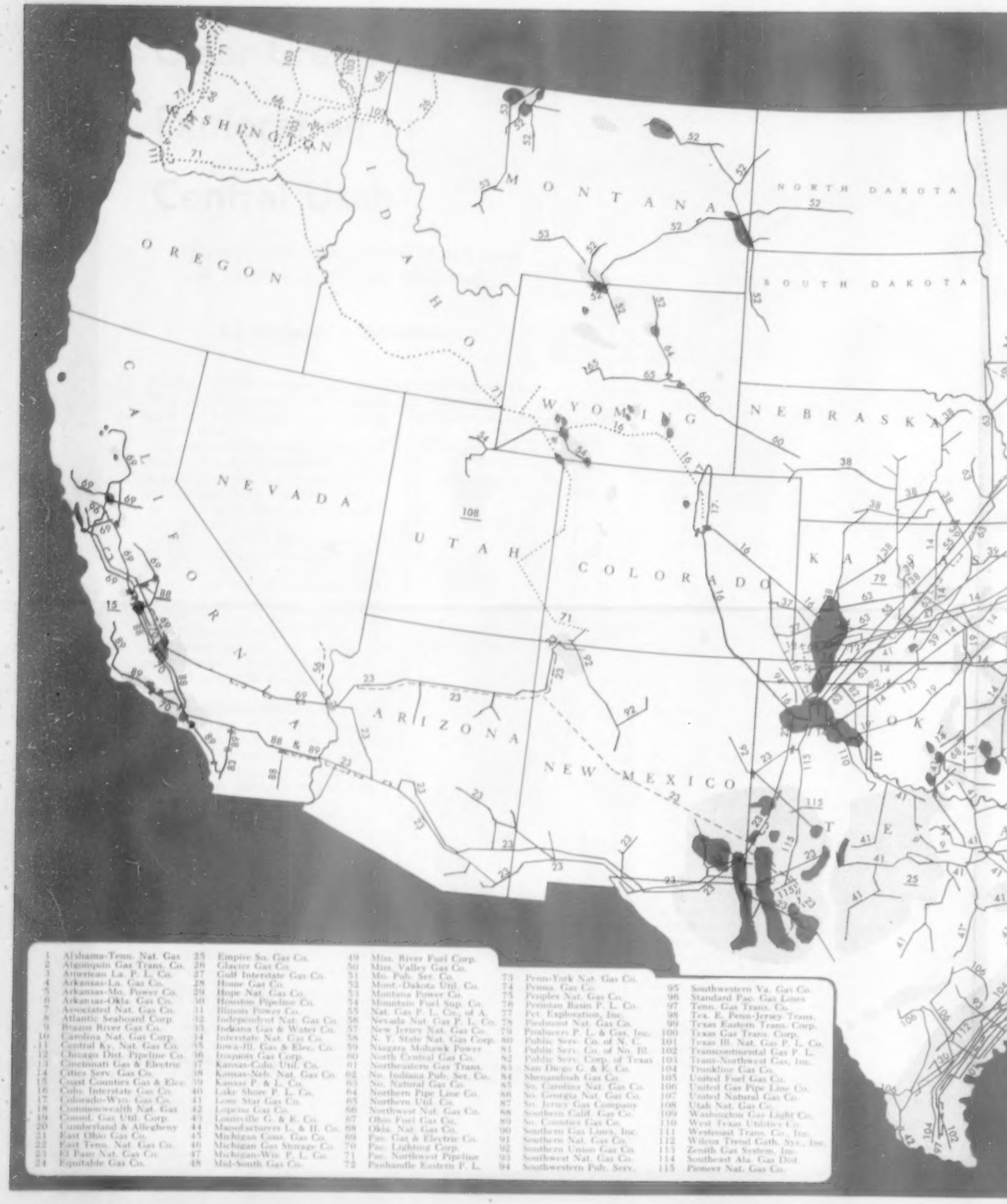
Another interesting discovery was that **sandy** cores had more extractable organic content and a higher percentage of hydrocarbons than **clay** cores. Question: could it be that the original hydrocarbon content of clays may migrate upward or downward into sandy phases? Or is it that organic matter deposited with sands is different in nature from that associated with clays?

In their eagerness to carry their findings to the absolute extremities, the experimenters at Esso scooped up one sample from the floor of the Gulf of Mexico off Corpus Christi to a depth of 1 ft., and analyzed it inch by inch as they had the deeper cores. The proportionate results were the same—hydrocarbons were present in approximately the same ratios as in the previous samples.

Significance . . . Lastly, these investigators indulged in some projected reserve estimating that is a little astonishing. They concluded that if these disseminated hydrocarbons in recent sediments were able to collect in a favorable porous medium, an oil pool of impressive size would result. Their estimates ranged from 5 million barrels per cubic mile of sediment offshore at Santa Cruz, Calif., and Grande Isle, La., to 10.4 million barrels off Pelican Island, La.

The important impact of these experiments warrants more research of this nature; we are approaching an answer to one of the oldest questions in the petroleum industry—the origin of oil. These tests have shown that in sediments now being deposited in our offshore areas, millions of barrels of tomorrow's oil are dissipated through the depositing sands and clays—tiny particles of petroleum that will some day accumulate in a porous earth body to form an oil pool.

Question: how do they get together?



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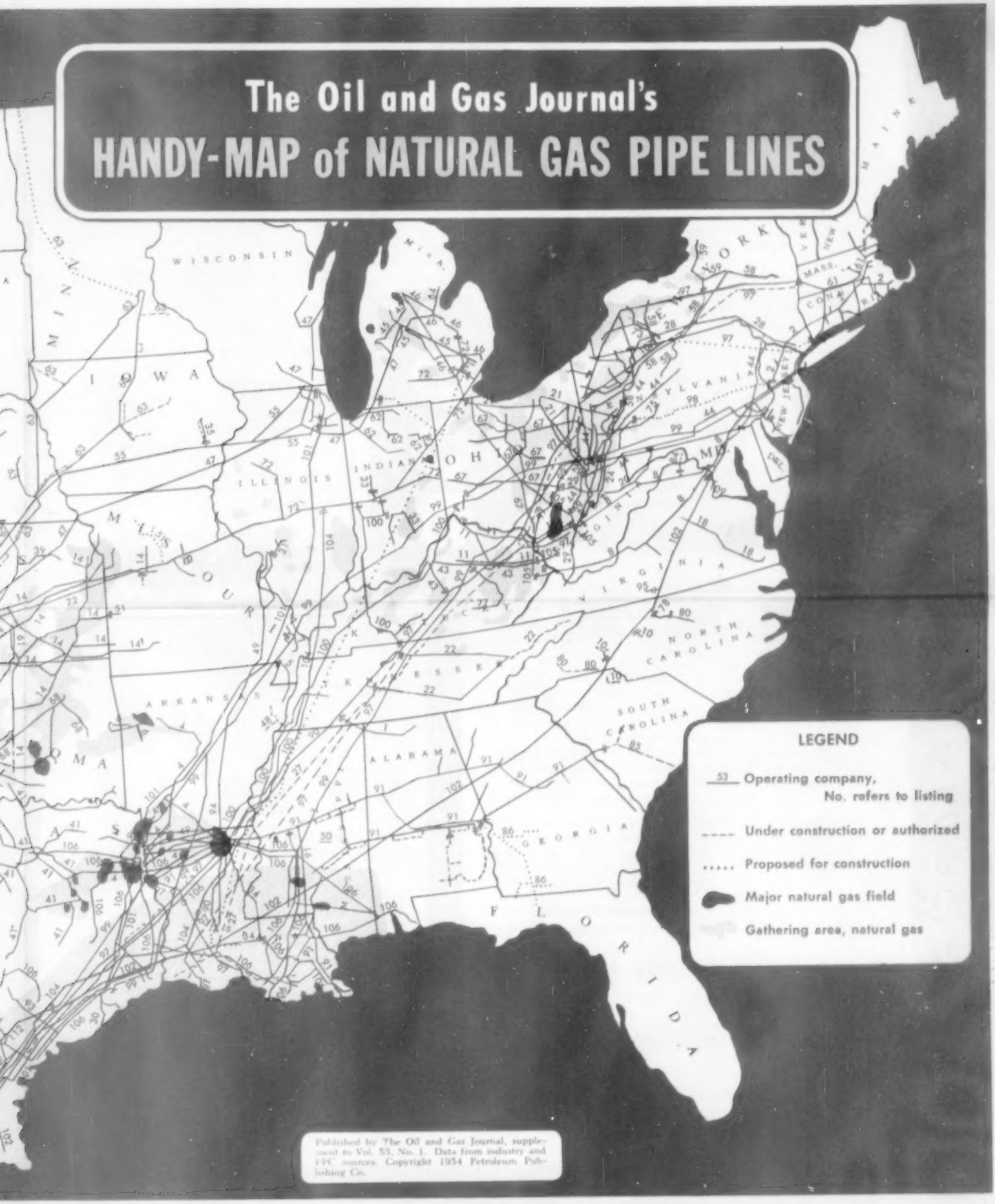
The Oil and Gas Journal's
HANDY-MAP of NATURAL GAS PIPE LINES



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Clear Creek Spurs Exploration in Central Utah

Fourteen wells have proved 21,600 acres with reserves of a trillion cubic feet

by Norman S. Morrisey

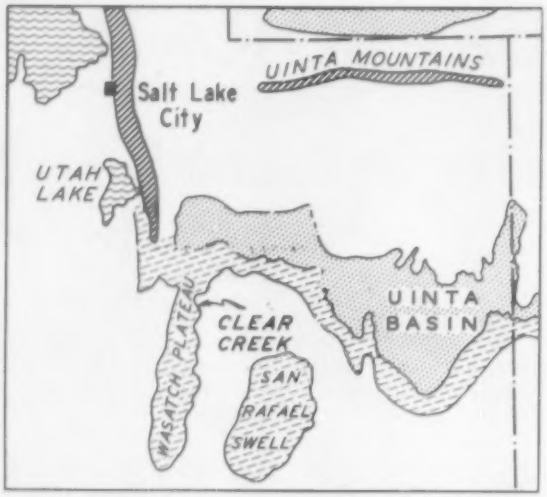

Fig. 1—Clear Creek gas field in the rugged Wasatch Plateau of Central Utah provides gas for the Salt Lake City area.

CLEAR CREEK gas field with its tremendous gas reserves of 1 trillion cubic feet has stimulated exploration in Central Utah.

If reserves can be doubled, a pipeline from Utah to the Pacific Coast markets is probable. The field is located 100 miles southeast of Salt Lake City in the rugged and mountainous Wasatch Plateau (Fig. 1).

Two key wildcats will be drilled on the Wasatch Plateau this summer. Three States Natural Gas Co. plans a 5,000-ft. Ferron sand test on the Elbow Unit that lies 6 miles north of Clear Creek gas field. Stanolind Oil & Gas Co. has received federal approval for drilling its Soldiers Summit Unit, located 20 miles north of Clear Creek. Objective is the Ferron sand at about 6,400 ft.

Reserves and daily production . . . To date there are 21,600 acres proved productive by the 14 wells in Clear Creek field. Operators estimate gas reserves of 46 M.M.c.f. per acre. On this basis, reserves exceed 1 trillion cubic feet for the Ferron sand.

At the present time daily production is 50 M.M.c.f. per day from 14 wells. Price of the gas at the well is 15 cents per M.c.f.

The gas at the field enters Utah Natural Gas Co.'s 18-in. line for shipment to Provo. At Provo, it is shipped to the Salt Lake City market via Mountain Fuel & Supply Co.'s pipeline.

The gas is dry and contains 97 per cent methane and 3 per cent ethane.

Geology . . . The Clear Creek structure is a broad anticlinal nose with about 500 ft. of fault closure (Fig. 2). Several north-south faults cut the producing area. The major one lies along the east side of the field and has a throw of 1,500-2,000 ft. The faults apparently are relatively high-angle normal faults that form horsts and grabens within the producing area. A second set of faults, trending east-west, is of minor importance with displacements ranging from 10 to 200 ft.

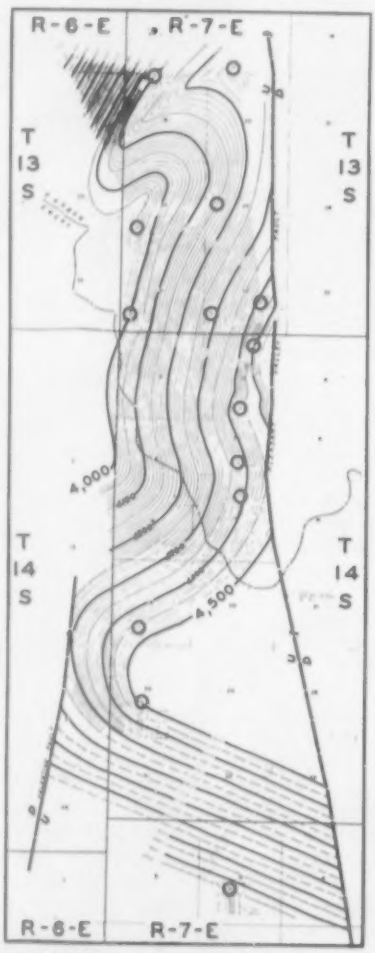

Fig. 2—Clear Creek is a broad anticlinal nose with about 500 ft. of fault closure. Daily production is 50 million cubic feet from 14 wells.

The anticline is reflected in the surface Eocene and Upper Cretaceous beds and was originally mapped in the early twenties by the United States Geological Survey.

Several east-west igneous dikes have been mapped. These basic intrusives are 10 in. to 10 ft. wide. They cut the Cretaceous beds but do not enter the overlying Eocene rocks. Locally where the dikes cut coal beds, the coal has been altered to coke. At the Winter Quarters mine, the zone of contact metamorphism is 15 ft. thick.

Reservoir rocks . . . Gas production on Clear Creek anticline was established in November 1951, upon completion of Three States Natural Gas Co. 1 Utah Fuel with an initial production of 11.7 M.M.c.f. Principal producing zone in the field is the Ferron sand (Cretaceous) which is considered equivalent to the Frontier of Wyoming. The Ferron consists of at least seven separate sands. The zone is about 430 ft. thick and the average pay thickness is 120 ft. The seventh sand is the most persistent reservoir and is probably present on the outcrop near Price, Utah, 30 miles from the field.

Depth to the producing zone ranges from 4,000 to 6,600 ft.

The reservoir beds in the Ferron are fine to medium-fine-grained bentonitic sandstones with an estimated porosity of 12 per cent. No data are available concerning permeability, connate water, etc., because the wells are not cored and cuttings are too small to be analyzed.

Wells are completed for high initial

potentials. Largest well in the field is Three States Natural Gas Co. 1-X Paul Walton; it gaged 136 M.M.c.f. on open flow potential. Several wells have been completed for initial potentials greater than 100 M.M.c.f.

Deepest production in the field is from the Dakota. One well was completed in this zone for an initial potential of 6 M.M.c.f. per day. In addition to the Dakota, the conglomerates in the Morrison formation are potential reservoirs.

Drilling and completion practices . . . Customary practice is to drill to the top of the Ferron using rotary tools after setting surface pipe. At this point 7-in. casing is set.

Because of the bentonite in the Ferron sands, the pay is drilled with gas as the circulating medium *(see The and Gas Journal, March 8, 1954, page 60)*. The gas is piped in from the nearest well and connected to the drill pipe. Approximately 2 M.M.c.f. of gas per day is used under 400 psi. pressure. The gas is released through a flare manifold and burned.

Wells are usually completed natural from the open hole. Operators plan to use fracture methods at a later date and then run perforated liners to total depth.

Gamma ray, neutron, ordinary Schlumberger and, if possible, Micro-Log surveys are run on all wells for correlation purposes and reservoir data.

Drilling problems . . . Lost circulation is a constant problem in drilling in Clear Creek field because of the faulting and fracturing of the Mancos shale. Sawdust, cottonseed hulls, and gunny sacks have been used to prevent the loss of mud.

At the present time operators are drilling one well with cable tools to determine if this method is more economical than drilling with rotary tools. As mentioned above, the customary practice is to drill through the pay sands using gas as the drilling medium.

Cost per well . . . The cost of drilling a field well in Clear Creek field is extremely variable because of the terrain, climate, circulation problems, and depth to the producing zones. Operators estimate that a field well will cost at least $100,000. The figure may be doubled if drilling problems are encountered.

Road building in the area is expensive. The terrain is rugged with elevations ranging from 8,000 to 12,000 ft. Operators have already built 50 miles of all-weather dirt roads; on some wells the access roads are a major expense.

Minimum cost for road building is about $1,000 per mile. This figure is not an average, however, because in bad stretches the cost increases rapidly.

Weather conditions . . . During early development of the field, the weather was a constant source of trouble. In order to meet pipeline requirements of 35 M.M.c.f. per day, operations continued throughout the first two winters. On the Wasatch Plateau, 30 ft. of snow and temperatures of 48° below zero were recorded during these periods. Drilling operations are seriously handicapped in the winter.

Because of the snowslides in the spring, the christmas tree is set in a heavily reinforced-concrete cellar. Road maintenance in the summer is a problem because cloudbursts frequently wash out the roads and bridges.

Future prospects . . . Exploration efforts in the Wasatch Plateau have been stepped up, largely because of the production at Clear Creek gas field. The field may be the most important factor in the construction of a pipeline from Utah to the West Coast.

Acknowledgment

Much of the information on the Clear Creek gas field was supplied by Three States Natural Gas Co., Dallas, through its chief geologist, Grady H. Laughbaum.

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KANSAS

Free Oil Tested at Kingman Prospect

Midstates Oil Corp. and M. B. Armer have tested free oil at 1 Ravenstein in Kingman County, NE NW NW 4-30s-6w.

The wildcat is 4 miles southwest of Orsemus pool in the southeastern part of the county. The tests were made in the Lansing and Kansas City limes.

Harpers Ranch Has Indicated Extension

Harpers Ranch field in Clark County has an indicated ¼-mile east extension at Pure Oil Co. 1 Harper, SW SW 2-34s-21w. A drill-stem test at 5,435-53 ft. flowed 25 bbl. of oil per hour with recovery of 2,400 ft. of gassy oil. Test was made in the Morrow sand.

Second Oil Pool Indicated in Haskell

Haskell County in the Hugoton gas field area of southwestern Kansas has its second oil pool indicated at Bennett & Roberts 1 Boatwright, SE SE SE 13-29s-32w, arrowed on map.

The wildcat is 5 miles northeast of the town of Sublette on the east flank of Permian production in Hugoton gas field. Recovery on a drill-steam test in the Pennsylvanian-Lansing topped at 4,283 ft. was 220 ft. of oil.

Pump is being installed at the county's first oil pool, Helmerich & Payne 1 Jones, C SW SW 4-27s-34w, 11 miles southwest of Beyer field in Finney County. The deep Hugoton field test swabbed 11 bbl. of oil per hour from the Mississippian.

Purdy Sand Oil Production Assured at Greenwood Test

Flowing Purdy sand (Basal Pennsylvanian) oil production is assured at Stanolind Oil & Gas Co. 1 U.S.A. "C," SW 29-34s-43w, first oil well in Greenwood gas field, Morton County.

The well topped Lansing at 2,957 ft., upper Morrow at 4,192 ft., Keyes sand at 4,458 ft., and lower Morrow at 4,472 ft. Perforations are at 4,210-16 ft. in the Purdy sand, which produces in the Oklahoma Panhandle area.

New Pools Named

The Nomenclature Committee of the Mid-Continent Oil and Gas Association recently gave names to eight new pools in Kansas.

Central Kansas uplift . . . Lewis Drilling Co. 1 Welsh, SW NW SE 20-19s-12w, Barton County, opened James pool in the Lansing. E. K. Carey Drilling Co. 1 Munns, CN½ NW SE 23-17s-13w, an Arbuckle discovery, opened Hoisington East pool in Barton for 240 bbl. of oil daily.

Imperial Drilling Co. 1 Brown "A," SW SW NW 21-10s-23w, opened Happy pool in Graham County with a bomb potential of 2,805 bbl. of oil per day from the Lansing. North Coats pool was opened at Lario Oil & Gas Co. 1 Shriver, NW SW SE 12-29s-14w, finaled for 104 bbl. of oil per day in the Lansing. It is in Pratt County. Greenland Drilling Co. 1 Isern, NE NE NE 14-24s-15w, a Viola producer, opened Macksville East pool in Stafford County. Republic Natural Gas Co. 1 Fair "A," NW SW NE 9-22s-11w, opened north Shepherd pool in Stafford County with production from conglomerate.

Sedgwick basin . . . The Texas Co. opened Orsemus South pool in Kingman County at 1 Callison, NW SW NW 31-29s-5w, as a Viola producer. Carter Oil Co. 1 Antrim, NW NW NE 25-31s-9w, a Mississippian discovery, opened South Grabs pool in Harper County.

INDIANA

In Clinton County O. W. Mayhew et al 1 Binkley, 10-2s-11w, 2 miles west of Princeton, swab tested ¾ bbl. of oil per hour after perforating in the upper Cypress sand at 1,952-59 ft. This is the first such production in the area.

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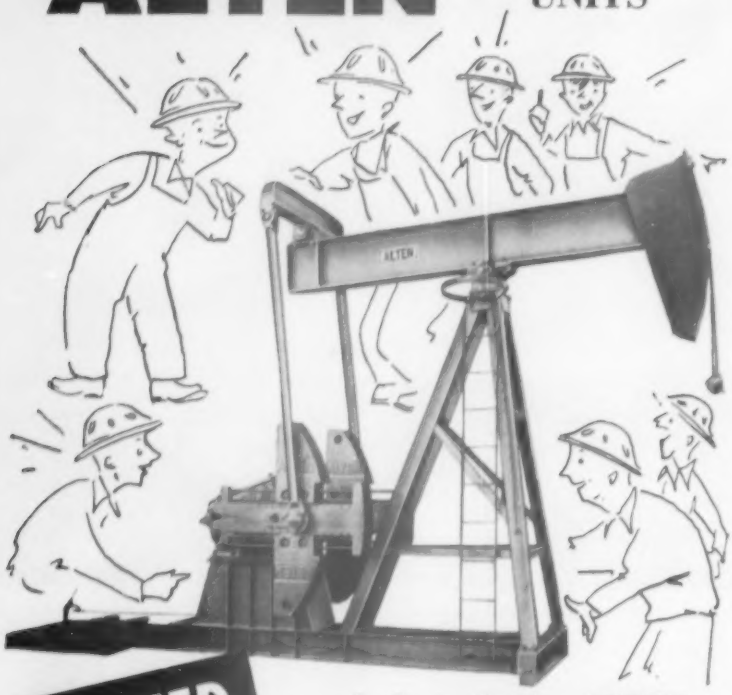

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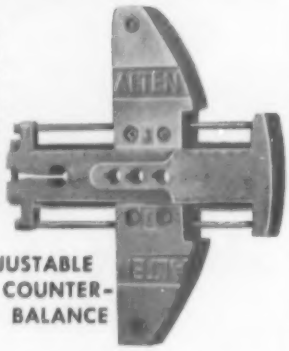

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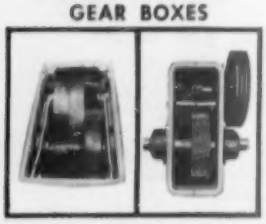

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CALIFORNIA

New Pool Discovery in Degany Gap Area

Gilliland Oil Co. and H. F. Ahmanson have made a new pool discovery in the Degany Gap area of Kern County. Northwest of Devils Den production in SW SE 3-25s-18e, the operators have completed 1 Miller for a daily average production of about 100 bbl. of 23°-gravity clean oil. Well flowed for a short time, but is being placed on the pump. Total depth is 1,667 ft. A southerly offset, 6-A Alferitz on Section 10, has also found the Miller zone productive, but has been carried on down to 1,905 ft. for a test of the Canoas shale zone.

Edison Outpost Test Makes 40°-Gravity Oil

Standard of California has completed an outpost well west of Edison field in Kern County which may prove to be a new fault block discovery from the Jewett or Pyramid Hills formations, or both. The company's 78-8 Jeppi-Camp in SE SE 8-30s-28e, flowed at the rate of 2,000-2,500 bbl. a day of 40.5°-gravity clean oil on a short test of the interval 5,965-6,017 ft. The well was assumed in scout reports to be a northerly offset of Dumm Brothers Petroleum Corp.'s 1 Doc Crandall, recent Nozu sand discovery, but Standard went on down almost 1,000 ft. before making a test, leaving the Nozu behind the pipe. Standard has production of 37 gravity oil two locations west of the new producer. Badly-faulted character of the Edison area makes speculation difficult until the operator releases more information about the new well.

Good Well in North Guijarral Hills Pool

Union Oil Co.'s latest completion in North Guijarral Hills pool in Fresno County, which it discovered last January, gives new evidence that this pool represents a fairly important addition to the state's reserves. Union's 6-26 Whittemore in Section 26-20s-16e, flowed at the rate of 1,499 bbl. a day of 38.2°-gravity oil through a 25/64-in. choke on a 4-hour test with a cut of 8.3 per cent, which is expected to be reduced sharply. Producing interval is 8,681-8,775 ft. Standard of California, only other operator in the pool, has four wells drilling with three near completion. Union has one. Its Whittemore producer is the fifth successful completion in the pool since its discovery last January.

Showings in Oxnard Well

Standard of California has had encouraging indications in another deep test east of Oxnard in Ventura County. The 1 Lucas, located 2,050 ft. south and 2,250 ft. east from 5th Street and Rice Road in Section 12-1n-22w, is reported to be flowing by heads and preparations being made to install pumping units. Tubing is hung at 8,400 ft. Well was drilled to 10,570 ft. and redrilled to 9,030 ft. Two deep tests have been completed on the Oxnard Plain in the last year, one by Standard and another by Lloyd Corp. The relation of the Lucas well to the other two has not been determined. Standard simply refers to it as a "deep pool test."

TEXAS

WEST TEXAS

Southwestern Borden County is Active Spot

New production from Spraberry sand and Pennsylvanian reef in southwestern Borden, and some in northern Howard County, has spurred development and exploratory drilling.

Phillips Petroleum Co. 1-B Clayton & Johnson, 2 miles southeast of Seaboard Oil Co.'s recent reef discovery, drilled into the reef at 8,226 ft., which was approximately flat with the discovery. First drill-stem test in the reef, from 8,233 ft., flowed gas in 30 minutes and recovered 3,300 ft. of oil and gas-cut mud, plus 130 ft. of clean oil. Operators shut down to run electrical surveys. Seaboard's well completed for 198 bbl. of oil a day from 4 ft. of pay from 8,236 ft.

Brahaney Drilling Co., Inc., 1 Acosta, extreme southwestern corner of Borden County, prepared to test in the Dean section of the Spraberry when salt water cut in. First test of the Pennsylvanian at 9,023-50 ft. flowed an average of 13 bbl. of oil for 4½ hours, then perforations at 9,034-44 ft. flowed 11 bbl. of oil for the first hour, through 23/64-in. choke, and from there started making water. Top of the reef was 9,028 ft., by samples, which was minus 6,217 ft.

Brahaney had filed application to drill three additional Pennsylvanian tests in the same area. These were to be 1 Fred Thomas, in Section 7; 1 Shortes in Section 5, and 1 Wiggins also in Section 5.

Northwest of Brahaney 1 Acosta, Texas Crude Oil Co. 1-44 Lester Brown, Section 44, started testing the Spraberry. The well flowed 127 bbl. of oil through ¼-in. choke in 24 hours from Spraberry perforations at 7,466-7,560 ft. This well tested salt water with a show of oil and gas in the reef, and flowed 18 bbl. of oil in 12 hours from perforations at 8,075-8,150 ft. Top of Pennsylvanian lime was 8,865 ft. Texas Crude has spotted location for 1-45 Brown as a Pennsylvanian test, as an east offset to 1-44 Brown.

Borden County . . . Texas Pacific Coal & Oil Co. 1 Hanson, ½ mile north of production in the Southeast Luther (Siluro-Devonian) field, developed a flow of gas and oil on drill-stem test of the Fusselman section at 9,905-24 ft. The well flowed for 5 minutes, with no gages or estimates. Top of the Fusselman was 9,905 ft.

Upton County deep test . . . Gulf Oil Corp., which has had considerable success in deep drilling along the fields of western Upton County, has made location for an Ellenburger test within the boundry of McElroy field. The new project will be 365 J. T. McElroy and is located in Section 195, Block F, CCSD&RGNG Survey. Contract depth is 12,500 ft.

Glasscock wildcat has oil show . . . Hunt Oil Co. 1 Houston, 6 miles east of Spraberry production, northwestern Glasscock County, developed a gas blow and recovered free oil on a drill-stem test in what is thought to be Wolfcamp. The test was run from 9,140-9,293 ft. Recovery was 1,100 ft. of fluid, being 50 per cent clean oil and the balance mud-cut oil. Operators were drilling ahead.

Mitchell County . . . McAlester Fuel Oil Co. 1-A Largent unloaded oil while coming out of the hole after testing between 8,465-67 ft., just above the Ellenburger sample-top at 8,530 ft. Recovery was estimated at 1,656 ft. of oil, plus 200 ft. of salt water in the bottom of the testing tool. A test in the Ellenburger from 8,687-8,797 ft. developed mud and sulfur water.

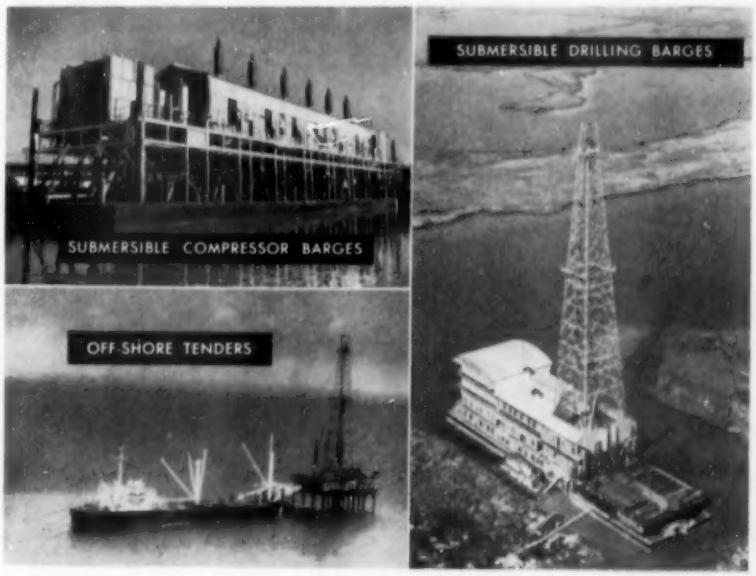
EAST TEXAS

Wildcat Tests Planned In Scattered Areas

Tops in the week's developments in East Texas fields was the announcement of several exploratory tests to get under way. Van Zandt County led with three wildcats located. These were Thomas D. Humphrey & Sons 1 M. T. Winnerbaum in west-central portion of the county. Exact location had not been reported, but it was said to be on a 242-acre tract in the William Droddy Survey, A-200, 6 miles west of Canton. Projected depth was 7,000 ft. Ace Drilling Co. will drill the hole.

W. F. Fadler and W. J. Brightwell, Henderson, will drill 1 Dewey Priest as a 5,900-ft. Paluxy test in the Antonio Y'Barbo Survey, 10 miles west of Canton, and Donald Bolls, F. R. Jackson and A. R. Graves will drill 1 Pitman as a 4,500-ft. test 1 mile northwest of Silver Lake.

Franklin County confirmation . . . Tide Water Associated Oil Co. and Seaboard Oil Co. have staked location for a confirmation Smackover test, ¾ mile northeast of their 1 Ramey Unit. The latter well had discovery production at 12,086-12,341 ft. and is considered one of the important gas-distillate strikes in East Texas.



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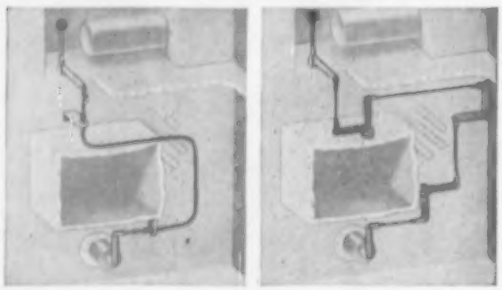

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The new operation will be 1-D Campbell Unit, located in the John Maxmillian Survey, and projected depth is 13,000 ft.

McCauley & Parker 1 Maurice Barron is a new operation scheduled to drill to 5,250 ft. in northern Franklin County. Application for drilling permit carried location as being in the J. A. Wimble Survey, A-529, 2 miles northwest of Hagansport.

TEXAS PANHANDLE

Hansford County Wildcat Tested Gas on DST

Colorado Oil & Gas Co. 1 Steel, 12 miles north of Spearman, and 6 miles southeast of the new Hitchland field, developed gas at the rate of 826,000 cu. ft. daily on test at 3,378-92 ft., and recovered 200 ft. of sulfur water; then tested at the rate of 349,000 cu. ft. daily on a test at 5,266-86 ft. Neither formation was identified.

Humble Oil & Refining Co. 1 Hart, northeast stepout to the Hitchland field discovery, flowed 10 bbl. of oil and 5 bbl. of salt water after fracturing in open hole between 4,638-55 ft.

In northwestern Hutchinson County, Gulf Oil Corp. 1 Amarillo National Bank had a show of gas in the Mississippian. Drill-stem test at 7,407-44 ft. recovered 275 ft. of slightly gas-cut mud. Operators drilled ahead.

TEXAS GULF COAST

New Producer Confirms Conroe Townsite Field

Moran Corp. and Gar-Flo Oil Co. have confirmed their discovery last January of a new Cockfield oil pool just west of the Conroe townsite, in Montgomery County, with the completion of their second well, 2 Hunt & Floyd, located 933 ft. north of the initial producer.

The confirmation well, producing from sand interval at 5,132-36 ft., flowed at the rate of 138.06 bbl. of 37°-gravity oil per day through ⅛-in. choke on completion gage. The discovery well, 1 Hunt & Floyd, flowed 134.7 bbl. per day through ⅛-in. choke from interval at 5,128-31 ft.

Three other tests now are drilling in the immediate area, designated as Conroe Townsite field. Locations have been made for four others.

Production Spreads in New Milton Oil Field

Production in the new Milton area, north of North Houston, in Harris County, has been extended a location southward with the completion by J. Huber Corp. and Columbian Fuel Corp. of their 3 Keng.

The new well, producing from the area's 6,700-ft. Yegua-Cockfield sand, flowed 77.46 bbl. of 37.4°-gravity oil daily through 8/64-in. choke, gaging 1,450-psi. pressure on the tubing. Producing interval is 6,708-10 ft.

This is the fourth producer for the area, opened last November. Wells, in addition to the discovery producer, include a northeast offset, an east offset, and the new southeast offset.

Third Oil Well Extends New Field at Cleveland

Another good oil producer, the third, for the new Cleveland Townsite (NW) field, 1½ miles west of Cleveland, in Liberty County,

has been completed by Floyd L. Karsten at his 1 Falvey et al.

The well, producing from Wilcox sand at 8,849-54 ft., flowed 157.11 bbl. of 35°-gravity oil per day on potential gage through 8/64-in. choke. It had a gas-oil ratio of 1,012 cu. ft. per barrel and flowing pressure of 1,225 psi.

Location is slightly more than ¼ mile south of the operator's 1 Robinson, recently reclassified as an oil producer in the same sand at 8,846-60 ft., after originally having been completed as a gas-condensate well. These wells are ¾ mile northwest of the discovery well.

SOUTHWEST TEXAS

New Offshore Oil Field Opened in Aransas Bay

Another offshore oil field, located in Aransas Bay, is being opened by Sunray Oil Corp. at its 1 State Tract 258, where testing of oil saturation in an upper Frio sand at 7,786-96 ft. is under way.

Testing through various sized chokes, the indicated discovery well produced at the rate of more than 200 bbl. of clean oil daily. Gravity of the oil is approximately 41°.

Location in Nueces County, about ¾ mile from the Aransas County line, and about midway between St. Joseph Island and the mainland, is 6 miles south of Rockport, Aransas County, and about 2 miles west of Blind Pass field, in the latter county.

Navarro Produces in New Charlotte Area Discovery

Texita Oil Co. and R. S. Hays have a new Navarro oil-discovery in the active Charlotte area, of Atascosa County, where their 1 Eggert is flowing at the rate of 80 bbl. of oil per day on final tests through 9/64-in. choke, gaging 1,200-psi. pressure. Producing interval is 5,416-19 ft. Location, in J. Poitevent Survey 9, is approximately a mile southeast of Charlotte field proper.

In the recently opened North Charlotte field, about a mile north of the main Charlotte field, John B. Coffee has a new Navarro producer at his 3-A Haskins. From pay at 5,051-57 ft., the well flowed 92 bbl. of oil per day through ⅛-in. choke.

OKLAHOMA

New Discovery Hinted In Beaver County Area

The Texas Co. has an indicated Morrow sand gas discovery in northwestern Beaver County in the Oklahoma Panhandle.

The 1-A Barby, NW NW 2-4n-27eCM, 10 miles northeast of Beaver City and 4 miles southwest of Northwest Knowles field flowed 2,500 M.c.f. of gas per day and recovered 100 ft. of distillate on Morrow test. The drill-stem test was made at 6,769-85 ft.

KENTUCKY

EASTERN KENTUCKY

In the Pike County sector of Big Sandy gas field, United Carbon Co. has completed 22 Republic Steel Corp. for an open flow potential of 315,000 cu. ft. of gas daily from the Big lime (Mississippian) formation. Formation was topped at 2,368 ft. and well was carried to a total depth of 2,620 ft.

Also, in Pike County, United Fuel Gas Co. has completed 6904 J. W. Justice as a dual gas producer from the Big lime which gaged 298,000 cu. ft. of gas daily and the Devonian black shale which gaged 581,000 cu. ft. of gas daily. Total depth of well is 4,247 ft.

ILLINOIS

Three New Oil Pools in Illinois In April

Illinois operators discovered three new oil pools in April, according to the State Geological Survey of the Department of Registration and Education. Productive acreage was also extended in four oil pools and two new pays were discovered in one other pool.

April oil production for Illinois was estimated at 5,322,000 bbl. Daily average production, which has been increasing for several months, reached 177,000 bbl., the highest since December 1949.

Two of the new oil pools are about 5 miles apart in Macon County. The Decatur North pool is northeast and Oakley pool is east of Decatur, some 20 miles northeast of the area of active drilling between Blackland and Mount Auburn. Both these new pools produce from Devonian-Silurian limestones.

The new discoveries near Decatur push northward the productive area of the Illinois basin. The only other oil pool that is farther north is the old Colmar-Plymouth pool in McDonough and Hancock counties, well outside the basin area.

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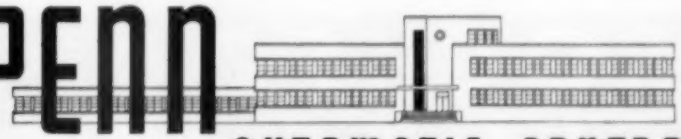

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The third new pool is Hill East in Effingham County, producing from the McClosky.

Productive acreage was extended in Blackland pool in Macon County, in Mount Auburn East pool in Christian County, in Clay City Consolidated pool in Wayne County, and in Roland Consolidated pool in White County.

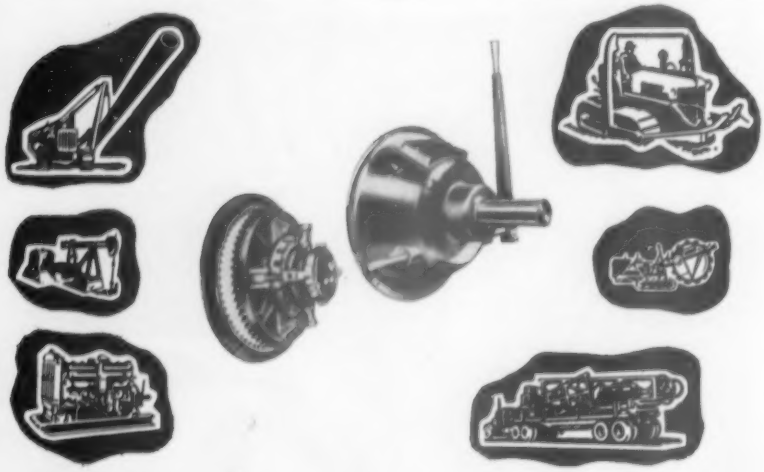
The Tar Springs and Cypress are new producing sands in Eldorado East pool in Saline County where most of the oil has come from the Aux Vases sandstone.

The big well in Boulder pool, 7 miles northeast of Carlyle, has attracted much attention. It is not producing at capacity because of lack of facilities to handle the oil. Hour-long open-gage flows indicate that the well could probably yield about 5,000 bbl. a day. This is the best well completed in the state in more than 10 years. The oil comes from Devonian limestone.

Three counties in which little or no oil was produced a year ago are now centers of interest because of recent oil discoveries. In Saline County, the recently discovered Raleigh, Eldorado, and Eldorado East pools are being actively developed. In Macon and Christian counties, the successful fracture-treatment of the Blackland well last December stimulated wildcat drilling which has resulted in discovering four new pools in the Blackland-Mount Auburn area.

In Clinton County Charles K. Stein's Louis Stein estate well in 36-3n-2w, 4 miles northeast of Carlyle on the east edge of Boulder pool, is flowing more than 18 bbl. of oil hourly through ¼-in. choke.

John Steele et al 1 Jones, 20-8s-7e, more than 1 mile from production in Saline County on the west side of Eldorado, is swabbing 4 bbl. of oil per hour from the Paint Creek sand after fracture treatment.



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LOUISIANA

NORTH LOUISIANA

Blackburn Well Yields Gas and Condensate

Pan Am Southern Corp. and Sunray Oil Corp. are preparing to drill through a full section of Justiss sand at 1 Monzingo, NE NE SE 31-22n-8w, Blackburn field well in western Claiborne Parish.

The new pay discovery, 1 mile south-southeast of the field discovery well, recovered gas and condensate on a drill-stem test in the Justiss sand of the Cotton Valley formation. Top of the Justiss was found in core at 9,319 ft. Discovery well of the field, the 1 Woods, NW SE 30-22n-8w, had only a slight Justiss show and was completed in the Bodcaw sand. The Bodcaw showed negative in the 1 Monzingo.

Bodcaw Being Cored At Lincoln Discovery

Feazel Interests, Southwest Gas Producing Co. and Hunt Oil Co. are coring the Bodcaw sand at 9,388 ft. at 1 Dowling, Lincoln Parish wildcat 3⅞ miles southwest of Hico-Knowles field.

Production has been assured in the "D" sand of the Cotton Valley on basis of drill-stem tests.

SOUTH LOUISIANA

Cote Blanche Completes Second 15,000-Ft. Well

Discovery late last year at Cote Blanche, St. Mary Parish, of production in sands below 15,000 ft. has been confirmed by The Texas Co. at its 23 State Lease 340, completed flowing 330 bbl. of 27°-gravity oil per day through 12/64-in. choke from perforations at 15,228-46 ft. Production in the deep sand was opened by the same company's 22 State, completed with perforations at 15,243-56 ft. Except for these wells, deepest production in the field is from a 14,400-ft. sand.

Oil Production Proved In New Eloi Bay Sand

Eloi Bay field, in St. Bernard Parish, opened late last year by Phillips Petroleum Co., got its second producer and a new pay zone with the completion by the same operator of its 2 State Lease 2221, east offset to the discovery well.

The new well, completed in sand perforated at 5,875-77 ft., flowed 483 bbl. of 29°-gravity oil per day through 12/64-in. choke under pressure of 780 psi. with gas-oil ratio of 190 cu. ft. per barrel.

The discovery well was completed originally as an oil producer in sand at 5,856-88 ft. More recently, after going dry, it has been recompleted as a gas well in sand at 5,778-82 ft.

New Pay Sand Discovery At Shuteston Confirmed

Pan American Production Co. is completing its second Tweedel-sand producer in the Shuteston area, St. Landry Parish. The new producer, 1 Burleigh, located on the northwest side of the main field, productive from the

shallower Nodosaria zone, confirms a recent discovery made in an outpost well, 1 Lavergne, ½ mile further west. The Tweedel production, opened by the latter well, was designated as West Shuteston field.

The Burleigh well, drilled in 1950 to 10,550 ft., where it was abandoned, was deepened to 11,100 ft., and with casing run to 10,929 ft., was perforated opposite the Tweedel zone at 10,944-50 ft. On tests through ¼-in. choke, it flowed at the rate of 175 bbl. of 36.8°-gravity oil per day with gas-oil ratio of 1,500 cu. ft. per barrel.

Production in the Lavergne well is from perforations at 10,897-910 ft. Initial flow was 4,500,000 cu. ft. of gas daily through ¼-in. choke with 30 bbl. of 45°-gravity condensate per million cubic feet.

New Deep Sand Opened In Phoenix Lake Field

A new producing horizon, the deepest so far uncovered in the field, has been opened at Phoenix Lake, in Calcasieu Parish, by M. H. Marr at his 1 Odom. The sand, reported as being in the Hackberry (basal Frio) zone, is producing from perforations at 9,780-92 ft., more than 1,100 ft. below the previous deepest pay. The well flowed at the rate of 173 bbl. of 37.5°-gravity oil per day through 8/64-in. choke under pressure of 1,500 psi. with gas-oil ratio of 202 cu. ft. per barrel. Hole was drilled to 11,550 ft.

New Lelux Well Confirms Gas-Condensate Discovery

Amerada Petroleum Corp. has confirmed its discovery, last January, of gas-condensate production in the Lelux area, northern Vermilion Parish, with the completion of its second producer, 1 Homer Trahan.

The new well, located ½ mile west of the discovery well, flowed at the rate of 59 bbl. of 49.8°-gravity condensate and 2,499,000 cu. ft. of gas per day through 10/64-in. choke. Its Miocene pay zone is perforated at 10,754-68 ft.

The discovery well's pay, in the same sand, is perforated at 10,758-75 ft.

Since the discovery well's completion, one dry hole, located ½ mile southeast of the discovery well, has been drilled.

MICHIGAN

A possible new discovery, or southwest extension of Lawton Traverse oil pool, Van Buren County, was under test this week in Decatur Township, at the Blunt Petroleum Co. 1 Shanahan, NE SE NE 24-4s-14w, located about ½ mile southwest of the older and original Lawton pool.

The Blunt 1 Shanahan logged to Traverse lime at 1,157 ft. and was drilled to 1,159 ft., total depth, where hole carried about 600 ft. of fluid natural in 12 hours. About half of the natural fill-up was reported to be oil. Well was being tubed earlier in the week and was scheduled to be acidized. On the basis of natural showings, the 1 Shanahan appeared to be typical of many other wells in the Lawton pool which were completed for average wells for the area.

But, Lawton field itself has been showing an alarming decline in production over the past several months and by virtue of this, despite many undrilled 1-acre locations in the pool, field activity has come to all but an abrupt halt.

According to recent production reports issued monthly by the Oil & Gas Association of Michigan, Lawton field produced a total of 19,116 bbl. in November 1953, from 41 wells. In December, with 45 producers reported, the pool accounted for a total of 16,684 bbl., while in January 1954, last month for which official report is available, the field produced only 10,484 bbl. from 49 producible wells.

General interest in the Northville area, in southeastern Michigan, was focused this week on a wildcat, located about 6 miles west and 2 miles north of the big Trenton oil discovery well at the 1 LeMaster. The wildcat, Alan S. Gray and Ray Whyte 1 Miller, NE SE SE 390-1n-7e, Lyon Township, Oakland County, logged top of Trenton objective at 4,491 ft. Long string of 5-in. casing was run at 4,510 ft. and well was being drilled in below that point.

ARKANSAS

Kiblah Extension Finaled in Lafayette

Benedum-Trees Oil Co. has completed its 2½-mile extension to Lafayette County's Kiblah field. The well flowed 192 bbl. of 47°-gravity oil per day through ⅜-in. choke from perforations at 6,006-14 and 6,020-30 ft. in the Mitchell sand, Gloyd zone of the Rodessa. The well is the 1 Caldwell & Lowe, C SW SW 3-20s-26w, 8⅝ miles southwest of Bradley near the Louisiana line.

Surface casing has been set at the 2 Caldwell & Lowe, C SE SW 3-20s-26w, 1,320 ft. east of the extension discovery well. The Kiblah discovery well is Sinclair Oil & Gas Co. 1 Nelson, SW NE 7-20s-26w, Miller County.

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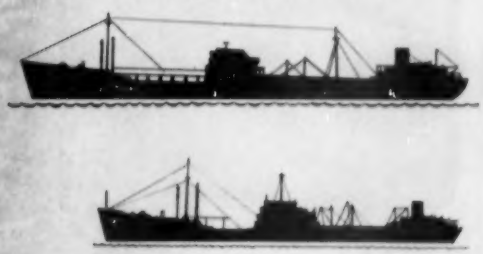

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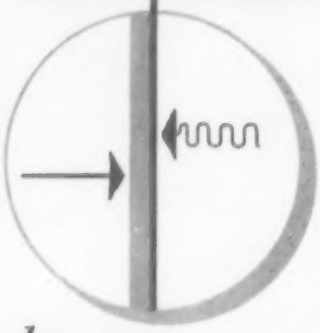

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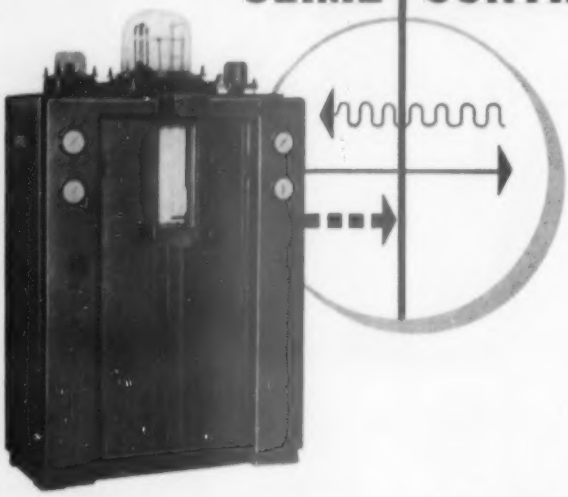

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CD-39

It was finaled last year with production from a lime porosity in the top of the Gloyd zone.

ROCKY MOUNTAIN

MONTANA

Central Area Report

Exploratory activity in the central portion of Montana is on the increase with the announcement of new wildcats in the area from Frannie northward to Hill County.

At A on map McAlester Fuel Co. and Goldston Oil Co. have made location for a 3,700-ft. Madison test at 1-A Rambo, C SW SW 35-31n-12e, in the Box Elder area of Hill County.

In Golden Valley County at B on map Heep Oil Co. has made location to drill in the Woman's Pocket area at 1 Reed, C SE SE 23-9n-19e. In Treasure County at C on map J. Ray McDermott has taken a farmout from Geo. J. Greer, trustee, and has made location for a 5,500-ft. Mission Canyon test at 1 Kelly, C SW SE 34-4n-34e.

At D on map Atlantic Refining Co. has made location for 1 Probestal, NW NE NW 25-9s-24e, in the Northwest Frannie area of Carbon County. The wildcat is a 5,700-ft. Tensleep test.

There is a general increase in interest in the central portion of the state in the area west of the Williston basin. Several majors have showed interest recently in the central and northwest part of Montana in areas where independents previously had been active.

COLORADO

Denver - Julesburg Basin Discoveries Tested

Wildcats in several areas of the Denver-Julesburg basin in Colorado have reported successful tests. McDermott & Barnhart, Denver, recovered oil from "J" sand on test of 1 Armstrong, C SW NE 34-9n-53w, 3 miles southeast of Mount Hope field in Logan County. Test was of the interval 4,890-97 ft. Oil flowed after 36 minutes at a rate not estimated by the operators. At last report the operators were coring below 4,930 ft. in this well, with further testing of the "J" sand in prospect.

Ginther-Warren-Ginther had gas at the rate of 2,530,000 cu. ft. per day on test of a wildcat in eastern Adams County. The well,

1 Leasure, SE SE SW 17-2s-59w, flowed in 5 minutes on test of the interval 6,265-89 ft. It is reported coring below 6,292 ft.

Roden & McRae Drilling Co., Denver recovered 6,000 M.c.f. of gas per day at 1 Glenn, SW SW SE 4-1n-57w, east of Adena field in Morgan County. This well is continuing to test.

Another apparent Colorado discovery is about 2 miles west of production at Padroni in Logan County. Claycomb, Guida and New Drilling Co. tested 1 Kelly, C SW NE 25-9n-53w, and reported a flow of oil from the "J" sand interval 4,828-66 ft. Recovery in pipe was 870 ft. of free oil and 60 ft. of water-cut mud. Flowing pressure was 80-510 psi. Casing has been landed and the operators are preparing for final testing. There was no show in the "D" sand at this wildcat.

NEBRASKA

Kimball County Discovery Swabbing

Shell Oil Co. is swabbing at the rate of 4 bbl. of oil per hour at 1 Schmid, SW SE 1-16n-54w, apparent discovery in Kimball County. The well is 12 miles north of previous production through the county. Exploration through this area of Nebraska has shown a northward expansion of interest for some time.

Cheyenne County Wildcat Tests Gas

Derby Oil Co. has landed casing at 1 Wilson, SE SE NE 13-12n-52w, Cheyenne County on the basis of recovery of gas at the rate of 880,000 cu. ft. per day on test of the "J" sand. Test was of the interval 5,174-86 ft. and tool was open 1¾ hours. Pipe recovery was 20 ft. of oil, 60 ft. of mud-cut oil, 60 ft. of oil-cut mud and 120 ft. of slightly gas-cut fresh water. The well is slightly more than 1 mile south of oil production in Malley pool.

WYOMING

Carbon County Gas Discovery Completed

Carter Oil Co. has completed 1 Savery Unit, C SE NE 17-13n-89w, Carbon County, for a flow of 874,094 cu. ft. of gas per day through ¾-in. choke. Production is from Mesaverde at 1,300-15 ft. The well was drilled to a total depth of 8,055 ft. in pre-Cambrian, and was plugged back to 1,428 ft. for completion.

The discovery is of interest as a further gas show within the Green River basin area of the state, where interest in gas prospects has increased materially over the past several months. It is about 20 miles southeast of Deep Creek where Amerada Petroleum Corp. discovered small Mesaverde gas production several years ago.

Niobrara County Dakota Discovery Near Completion

Buck Creek Oil Co. is completing 1 Government, NE SE SW 2-35n-64w, in the South Little Buck Creek area, Niobrara County. The operator recovered 1,290 ft. of 42°-gravity oil on test of the Dakota interval 4,029-58 ft. Top of Dakota was picked at 4,013 ft. The wildcat is separated from production in the South Little Buck Creek area proper by two failures which went to Dakota, and is believed to open a new pool in this area of the county. Principal new exploration in the county during recent months has been further to the north along the trend extending south from Weston County where Newcastle sand is the principal producing horizon.

APPALACHIAN AREA

WEST VIRGINIA

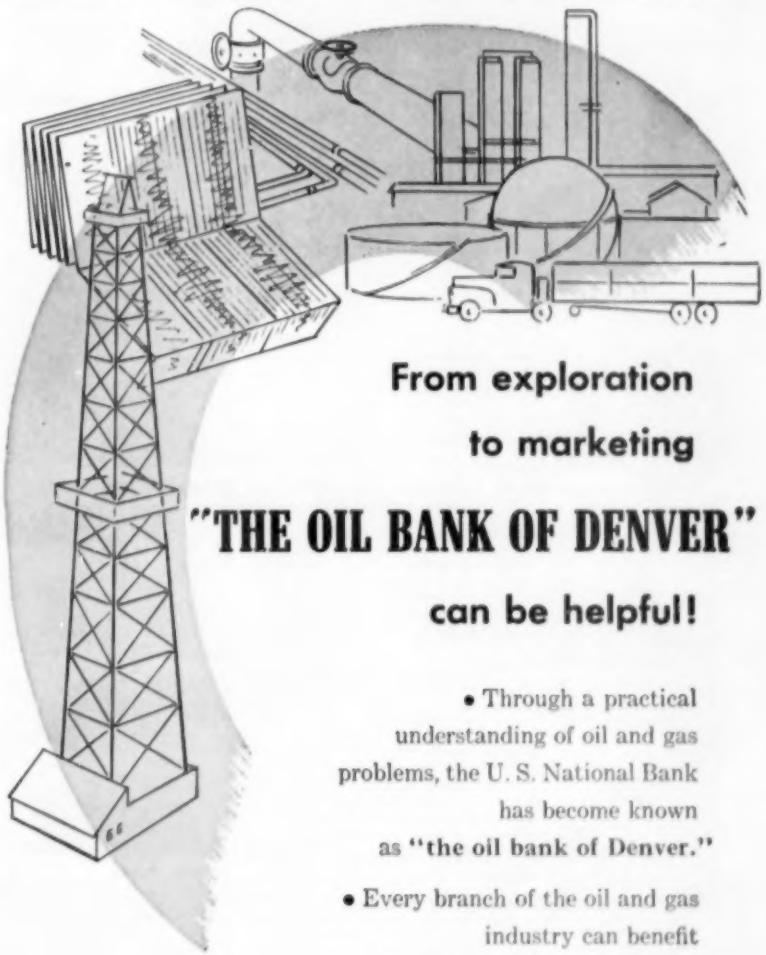
In St. George district, Tucker County, West Virginia, Natural Resources Corp. 1-2 Tucker County Court wildcat, elevation 1,586 ft., is running the 7-in. casing at 5,377 ft. The chert was reached at 5,377 ft. In Licking district, Snee and Eberly are drilling at 4,622 ft., in 1 W. H. Blair. The large show of gas in the chert has blown down to where it now tests 193,000 cu. ft. Jumping Branch district, Summers County, United Fuel Gas Co. 6788 J. Sanford Lilly, deep test is drilling at 8,105 ft.

PENNSYLVANIA

Monroe Township, Bedford County, Southwest Pennsylvania, John T. Galey, is drilling out cement at 2,257 ft., after running casing to shut off the water in 1 Donald H. Miller. Connellsville Township, Fayette County, Peoples Natural Gas Co. 4030 F. K. Buttermore heirs, is drilling at 5,774 ft. Cherry Hill Township, Indiana County, Chestnut Ridge Oil & Gas Co. 3 Ralph White, is at 3,312 ft. Unity Township, Westmoreland County, Peoples Natural Gas Co. 4017 J. A. Mills, is drilling at 6,592 ft.

OHIO

Richfield Oriskany pool was extended south into Bath Township, Summit County. H.



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Thompson Co. 1 George Papp, Lot 5, logged the sand at 2,170-2,228 ft. with a fill-up of 200 ft. natural and 45 bbl. after acidizing.

In Black Run pool in Licking County, a short extension was made on 1 Lewis Holbert in Lot 1, Perry Township, by the E. H. Everett Co. Clinton was found at 2,919-2,961 ft. and made 90 bbl. in 24 hours after fracturing. Two miles to the south in Hanover Township, Mid West Oil Co. 3 Stoops, Lot 11, was fractured in sand found at 2,956-3,003 ft., and produced 40 bbl. in 24 hours.

CANADA

Flow Test Made at Sarcee-Priddis Discovery

Shell Oil Co. and Home Oil Co., Ltd., perforated and ran a flow test in the lower porous zone at their Mississippian wet gas discovery well in the Sarcee-Priddis area of southern Alberta, rating gas in excess of 8,000 M.c.f. daily and condensate at about 59 bbl. daily.

This discovery well is 13 miles southwest of Calgary, 12 miles south-southeast of Jumping Pound gas field and 9 miles north of Turner Valley.

The strike was made during mid-March at Shell-Home 1 Sarcee, LSD 12, 6-23-3w5, on the Sarcee Indian Reserve, 1¾ miles north-northwest of the Royalite 1 Priddis, abandoned wildcat. Hole has been taken down to total depth 10,004 ft., plugged back to 9,988 ft. and production casing was perforated from 9,906 to 9,956 ft. An acid treatment was applied to that perforated section and a 4-hour flow test was run. The well produced gas at rate 8,100,000 cu. ft. daily and about 7.5 bbl. of condensate per 1,000,000 cu. ft. of gas—for a rate of about 59 bbl. daily. Gravity of that condensate is 48°, Shell officials stated.

Plans now call for perforating and flow testing in the upper porous section of the Rundle limestone. The 1 Sarcee entered the Rundle at 9,607 ft., or 5,061 ft. subsea, encountered about 47 ft. of upper porous zone and 187 ft. of porosity in the lower zone of the Rundle.

Manitoba . . . Another southwest Manitoba wildcat in the Woodnorth area has indicated prospects for discovery of crude oil in the Mississippian limestone. This venture is being drilled by Perry Fulk, an Illnois businessman, on farmout lands from the California Standard Co., about 55 miles west-southwest of Brandon.

The well, Perry Fulk 1 Daisie Longman, LSD 16, 27-8-28w4, is 4½ miles west of the B.A.-Canadian Superior 1 Woodnorth Mississippian oil discovery well, 4 miles southwest of the Cal-Standard 5-18 abandonment and about 6 miles south of Daly oilfield near Virden.

First reported drill-stem test was run in the Mississippian interval 2,507 to 2,448 ft. Recovery was 30 ft. of gasified oil-cut mud. Test from 2,498 to 2,523 ft. gave up 50 ft. of gasified oil, while test from 2,523-40 ft. yielded only 35 ft. of mud. Crew was preparing to run production casing bottomed at 2,889 ft. at last report.

Badger Lake . . . Four Canadian independents share in a southern Alberta wildcat that reported discovery of crude oil in the Madison limestone. This venture, being drilled by Scurry Oil, Ltd., Anglo Canadian Oil Co., Ltd., Calavan Consolidated Oil & Gas Co., Ltd., and Canada Oil Lands, Ltd., is in the Badger Lake area, some 25 miles southwest of Brooks.

The well, Scurry-Anglo 1 Calvan, LSD 7, 5-17-18w4, has previously reported small gas flows in two zones of the Bow Island sand formation. This wildcat strike is about 9 miles south of the Royalite-Anglo 1 Eyremore light gravity oil discovery well, 5 miles southwest of H.B. 1 Eyremore abandonment and 13 miles east of the Pacific Western 1 Lake McGregor unsuccessful exploratory venture.

The team's No. 1 well entered the Madison at 3,975 ft., or 1,225 ft. subsea (K.B. elevation 2,750 ft.), and ran drill-stem test from 3,975 ft. to 3,995 ft. When pipe was pulled it was found to contain 130 ft. of gassy oil-cut mud and 90 ft. of oil. Gravity of the oil has not as yet been specified. Later test, from 3,999 to 4,011 ft. yielded only 15 ft. of oil-cut mud, no water.

Scurry officials, operators of this project, stated that there are an estimated 25 ft. of porosity in the Madison at this site, and that indications warrant the setting of producion casing for evaluation tests. Currently, however, the well is coring below 4,031 ft.

Garrington . . . Another Alberta wildcat appears to have discovered crude oil in the Cardium sand, this time in the Garrington area, 24 miles northwest of Olds, 34 miles southwest of Red Deer and 65 miles north-northwest of Calgary.

No drill-stem production tests have as yet been carried out at the well, but on the basis of core recoveries oil success has been indicated. The Garrington well encountered 14 ft. of Cardium sand development (including 1 ft. with evidence of gas and 13 ft. of oil-stained core).

The well, Superior et al 11-7 Garrington, LSD 11, 7-35-4w5, is 2¾ miles northwest of the Superior et al 11-33 Garrington wildcat that found a noncommercial showing of light oil in the D3, and 48 miles southeast of the New Superior group's Cardium oil discovery well at Rocky Mountain House.

The Cardium zone was entered at 6,805 ft., or 3,170 ft. subsea (K.B. elevation 3,635 ft.), while the Cardium sand horizon was entered at 6,889 ft., or 3,254 ft. below sea level. After coring through the 14 ft. of sand, the 11-7 well completed at total depth 6,953 ft., and is now reaming out hole. Production string of casing has been run to total depth and the well is currently standing cemented, preparatory to perforating and produ.tion testing.

The Superior et al H.B. 11-33 Garrington well to the southeast entered the Cardium (chert) zone at 6,540 ft., or 3,043 ft. subsea (K.B. elevation 3,497 ft.), while the sand zone was topped at 6,614 ft., or 3,118 ft. subsea.

EASTERN CANADA

Gaspe . . . In the Gaspe Peninsula, Quebec Province, the 1 asphalt base, on the Galt Brook dome had completed motor repairs and is deepening below 2,125 ft. The well continues to make oil from the 1,196-1,202 ft. horizon, and formation shows no apparent change.

WILDCAT COMPLETIONS

SOUTHWEST TEXAS
District 1

Atascosa County: Barry & Moore 2 Downey, Noah Scott Sur., A-768. TD 1,961 ft.

Wilson County: Rock Hill Oil Co. and Royney DeLange 1 Mills, A. Benites Sur., A-45. Dry. TD 3,502 ft.

District 4

Duval County: O. W. Killam 1 Ruiz, H&GN Sur. 11, A-313. Dry. TD 4,631 ft.

Seaboard Oil Co. of Delaware 1 Lowe, AB&M Sur. 38, A-1758. Dry. TD 10,480 ft.

Hidalgo County: Sun Oil Co. 1-B Bentsen Brothers, Sec. 7, Newman's Subd., El Benadito Grant. Dry. TD 8,797 ft.

George K. Taggart 1 Kelly unit, Lot 4, Blk. 27, Steele & Pershing Subd. Dry. TD 6,302 ft.

Jim Hogg County: Pearl & Hill 1 Guerra & Son, Blk. 6, Majors Subd., W. J. Wheeler Sur. 639, A-343. Dry. TD 2,831 ft.

Jim Wells County: Blanco Oil Co. 1 Alexander, CL Lots 53 and 60, R. P. Haldeman Subd., SK&K Sur. 237, A-466. Dry. TD 5,500 ft.

Katz, Zoch & Howell 1 Kuznicki, Blk. 4, Sec. 5, Scott's Re-Subd., Benon Ranch. IP 143 BOPD, 16/64-in., 40°, perforations 5,539½-42 ft. TD 5,930 ft. (New field, or extends South Bentonville field).

Nueces County: Dorrance & Co., Inc., 1 Richter, Sec. 27, Benton Pasture Subd. Dry. TD 6,510 ft.

H. H. Howell and George E. Farenthold 1 Farenthold, Share 10, Bluntzer Partition. Dry. TD 6,212 ft.

Superior Oil Co. 1 Kelly, Share 5, Enriquez Villareal Grant, A-1 IP 2,420 M.c.f. daily, open-flow potential, gas-condensate ratio 42,700/1, 52.7°, lower Frio 10,053-67 ft. TD 10,573 ft. (New pay in South Clarkwood field).

San Patricio County: S. H. Howell 1 Leber, Blk. 3, Toribio Mclina Sur., A-18. Dry. TD 6,612 ft.

Sun Oil Co. 1 Brittain, J.A.F. Gravis Sur., A-140. Dry. TD 7,522 ft.

Starr County: Nelson Bunker Hunt 1 Arcadio Guerra est., Share A, San Jose Grant. IP 39 BOPD, ¼-in., 45.3°, perforations

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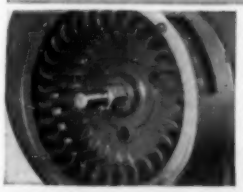

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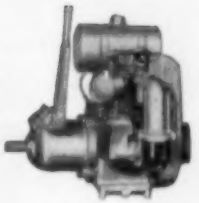
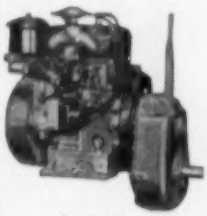


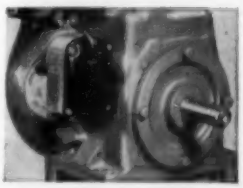
Single-cylinder 3 to 9 hp.

TAPERED ROLLER BEARINGS AT *BOTH ENDS* OF CRANKSHAFT . . .

These self-cleaning, file-hard bearings take up all load thrusts, permitting the use of either chain-, belt- or gear-drive direct from the extended crankshaft, without fear of damaging main or connecting rod bearings. This does away with the need for an outboard bearing.



2-cylinder 7 to 15 hp.



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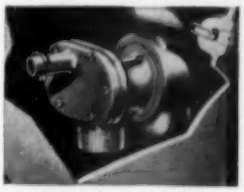

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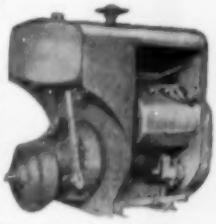

4-cylinder V-type 15 to 36 hp.

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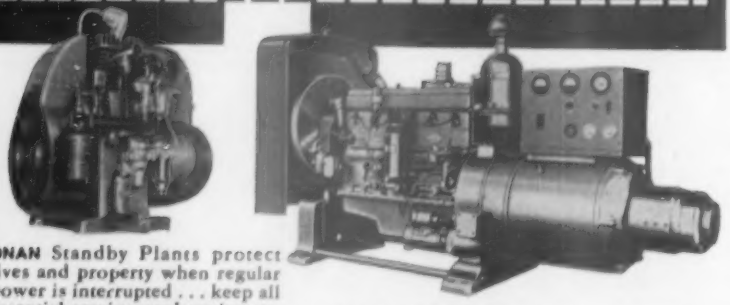

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Water-cooled: 10,000 to 50,000 watts. Powered by four and six-cylinder, heavy-duty engines.

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WILDCAT COMPLETIONS

6,870-76 ft. TD 9,518 ft. (New field—San Jose).

Webb County: Blanco Oil Co. and Killam & Hurd 1 Albert Martin, trustee, Sur. 696. Dry. TD 2,540 ft.

W. L. Cotton, Inc., and L. G. Shelly 1 Ambrosio Villarreal, M&C Sur. 1090. Dry. TD 2,350 ft.

Zapata County: Killam & Hurd 1 Trevino, Sur. 290. Dry. TD 2,005 ft.

TEXAS GULF COAST
District 2

Bee County: Kirkpatrick & Coates 1 Ellis, Thomas Simmons Sur., A-292. Dry. TD 5,005 ft.

Fred W. Shield 3 Heard, William Burke Sur. A-9. IP 6,000 M.c.f. daily, open flow, dry gas, perforations 3,673-85 ft. TD 4,553 ft. (Extends Heard field.)

DeWitt County: Kirkwood & Co. et al 6 Kuester et al, SA&MG Sur. 4, A-618. Dry. TD 8,515 ft.

Karnes County: George H. Coates 1 Cooley, William Gant Sur., A-132. Dry. TD 4,400 ft.

Lone Star Producing Co. 1 Esse, Morgan Grace Sur., A-118. Dry. TD 8,571 ft.

Live Oak County: Inca Drilling Co. 1 Miller, Blk. 83, Miller Ranch Subd., Jose Aldrete Sur., A-1024. Dry. TD 5,194 ft.

Kirkwood & Morgan, Inc., 1 Wright, M. B. Kivlin Sur., A-21. Dry. TD 5,302 ft.

Refugio County: Stanolind Oil & Gas Co. 1 O'Connor, William Donaho Sur., A-135. Dry. TD 8,448 ft.

District 3

Chambers County: J. Keet Lewis 1 Williams, BBB&C Sur., A-61. Dry. TD 6,417 ft.

Hardin County: J. S. Abercrombie et al 1 Hooks et al, Wiley G. Powell Sur., A-425. Dry. TD 8,172 ft.

Harris County: Brewster-Bartle Drilling Co., Inc. et al 1 Sodek, D. D. Culp Sur., A-810. Dry. TD 9,147 ft.

Ellis B. Colvin and C. W. Magalis 1 Compton, Lot 8, Blk. 1, Sec. 91, Meadowbrook Farms Subd., WCRR Sur. 2, A-1121. Dry. TD 7,926 ft.

Olympia Oil & Gas Co., Ltd., 1 Hine, Arthur McCormick Sur., A-46. Dry. TD 7,639 ft.

Olympia Oil & Gas Co., Ltd., 1 Thayer, Arthur McCormick Sur., A-46. Dry. TD 7,622 ft.

Montgomery County: Christie, Mitchell & Mitchell 1 Neidigk, Cyrus Dikeman Sur., A-178. Dry. TD 6,296 ft.

Moran Corp. and Gulf Coast Leaseholds, Inc., 1 Risher et al, Denward James Sur., A-289. Dry. TD 6,475 ft.

Orange County: Richard M. Wright 1 Perry et al, T. Strong Sur., A-25. Dry. TD 9,013 ft.

Walker County: Jack Clark 1 Beardsley et al, L. M. Collard Sur., A-10. Dry. TD 4,080 ft.

Wharton County: W. V. Bowles & Co. 1 McIntyre et al, M&C Sur. 25, A-288. IP 6,700 M.c.f. daily, open flow, dry gas, Frio 5,484-90 ft. (perforations). TD 7,250 ft.

EAST TEXAS

Freestone County: Byrd Oil Corp. 1 McMichael, S. B. Owens Sur., A-482. Dry. TD 8,245 ft.

Henderson County: Mack Hayes, Jr. 1 Arnold, James M. Gardner Sur. Dry. TD 3,300 ft.

Rusk County: Pan American Producing Co. 1 Martin, Thomas O'Bar Sur., A-26. Dry.

WILDCAT COMPLETIONS

TD 7,464. Elev. 314 ft., Pettit 6,657 ft., Travis Peak 6,932 ft.

Upshur County: Wimberly & Keeler Oil Co. 1 Skidmore, John Parker Sur., A-390. Dry. TD 5,620 ft.

WEST CENTRAL TEXAS

Brown County: Harold John 1 Turner, M. P. Jones Sur., A-14. Dry. TD 2,754 ft.

Callahan County: A. W. Krause & Associates 1 McKinney, Sec. 2292, TE&L Sur. Dry. TD 3,300 ft.

Schkade Bros. Drilling Co. 1 Jackson, 96-12-T&P. IPP 36 BOPD, 36°, pay 868 ft. TD 876 ft.

Taubert & Harper 1 McFarland, Sec. 132, BBB&C Sur., A-681. Dry. TD 3,510 ft.

Coleman County: Sandor Petroleum Co. 1 Connelly, J. Stapp Sur. 42. Dry. TD 2,626 ft.

Eastland County: Evans & Dickey 1 Criswell, Pleasant A. Barnhill Sur. 53. Dry. TD 1,661 ft.

Erath County: Mayfield & Newman 1 Leatherwood, E. Misenhelter Sur. 557. Dry. TD 1,000 ft.

Fisher County: Signal Oil & Gas Co. 1 Trammel, Subd. 19, Austin & Williams Sur. 349. IPP 28 BOPD, 36°, pay 4,995 ft. TD 5,080 ft.

Haskell County: The Texas Co. 1 Wright, Subd. 9, G. C. Alfore Sur. 43. Dry. TD 5,946 ft.

Sojourner Drilling Co. 1 Frierson, Sec. 52, J. E. Ellis Sur., A-127. Dry. TD 5,186 ft.

Jones County: Jones & Stasney 1 Smith, Sec. 58, BBB&C Sur. Dry. TD 3,756 ft.

Robinson-Puckett and Rock Hill Oil Co. 1 Stephens, Sec. 50, OAL Sur. Dry. TD 4,532 ft.

S. B. Roberts 4 Fields, Samuel Andrews Sur. 191. Dry. TD 1,952 ft.

Sojourner Drilling Co. 1 Mayfield, Sec. 2, D&DA Sur. Dry. TD 2,705 ft.

Nolan County: General Crude Oil Co. 1 Wimberly, 37-5-T&P. Dry. TD 7,011 ft. Elev. 2,513 ft., Ellenburger 6,205 ft., Cambrian 6,688 ft., pre-Cambrian 7,002 ft.

Palo Pinto County: Dublin-Kiel 1 Gauldin, Sec. 1740, TE&L Sur., A-515. Dry. TD 1,370 ft.

F. Kirk Johnson 1 Caudill, J. Poitevent Sur., A-1058. Dry. TD 1,812 ft.

Parker County: Moran Brothers, Inc. 1 Darnell, 173-1-T&P. Completed as shut-in gas well, no potential. TD 3,245 ft.

Shackelford County: Johnson & Warren 1 Jackson, 96-12-T&P. Dry. TD 1,202 ft.

Stephens County: Bolin Oil Co. 1 Carrell, G. Newton Sur., A-127. Dry. TD 3,192 ft.

Lone Star Production Co. 1 Tipton, Sec. 2960, TE&L Sur. IP 235 BOPD, ½-in., 44°, Ellenburger 4,142 ft. TD 4,165 ft.

Southard Oil Co. 2 McKeen, 47-5-T&P. Dry. TD 4,500 ft.

Taylor County: Howsley & Jacobs 1 Casady, 25-18-T&P. Dry. TD 5,107 ft.

Sid Katz Exploration Co. 1 Benton, Sec. 45, LAL Sur. Dry. TD 4,816 ft.

Throckmorton County: Russell Maguire 1 Swenson, Sec. 7, GC&SF. Dry. TD 5,469 ft. Mississippian 5,368 ft.

Texkan Oil Co. 1 McKinney, Sec. 3015, TE&L Sur. Dry. TD 3,800 ft.

NORTH TEXAS

Archer County: Ada Oil Co. 1 Bloodworth, John Kelly Sur., A-243. Dry. TD 4,699 ft.

Bridwell Oil Co. 1 Vieth, 49-3-Clark & Plumb Subd. Dry. TD 4,739 ft.

Moncrief & Wiley Oil Co. 1 Garvey, Sec. 1887, TE&L Sur. Dry. TD 1,022 ft.

Baylor County: Bridwell Oil Co. 1 Hunt, Colorado CSL Sur. Dry. TD 3,951 ft.

Megargel Drilling Co. and G. W. Cooper 1 Higgins, Blk. 17, D&W Sur., A-642. IPP 25 BOPD, Cisco sand 1,414 ft. TD 1,417 ft.

Megargel Drilling Co. 2 Skelley, Blk. 2457, TE&L Sur., A-477. Dry. TD 1,589 ft.

Clay County: M. J. Frances 1 Harding, MEP&P Sur., A-350. Dry. TD 1,103 ft.

Frank Wood Associates 1 Copeland, Blk. 2636, TE&L Sur. Dry. TD 4,461 ft.

Cooke County: Sussex Oil Co. 1 Meador Bros., J. V. Bates Sur., A-190. Dry. TD 3,315 ft.

Grayson County: H. F. Gibson 1-A McCoy, E. Hartzog Sur., A-505, 3½ miles NW Sadler. IP 254 BOPD, 10/64-in., Oil Creek 7,594 ft. TD 7,599 ft.

Ralph Harper 1 Simmons, Blk. 5, M. B. Lamar Sur., A-704. Dry. TD 6,818 ft.

Jack County: Hale Bros. & Pawley Oil & Gas Co. 1 Hoefle, J. W. Barrett Sur., A-48. Dry. TD 3,747 ft.

Russell Maguire 1 Richards-476, S. O. Pennington Sur., A-476. Dry. TD 5,334 ft.

Marine Production Co. 1 Pursley, C. Vandivor Sur., A-867. Dry. TD 5,708 ft.

Knox County: Skelly Oil Co. 1 Price, 10-2-D&W. Dry. TD 6,928 ft. Elev. 1,649 ft., Ellenburger 6,033 ft.

Montague County: J. G. Dyer 1 Stone, 23-5-H&TC. IPP 28 BOPD, 40°, conglomerate 5,901 ft. TD 6,005 ft.

Wichita County: Glade Production Co. 1-A McClure, GC&SF Sur. 5, A-363. Dry. TD 3,124 ft.

Wilbarger County: Frank Wood 3 Waggoner "Victory," Sec. 40, MEP&P Sur., A-494. Dry. TD 1,170 ft.

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WILDCAT COMPLETIONS

Young County: Brown Drilling Co. 1-A Stewart, TE&L Sur. 229. Dry. TD 1,030 ft.

Dillard & Waltermire 1-A Allar-Hunt, Fractional A TE&L Sur. IPP 58 BOPD, 39°, Strawn 2,660 ft. TD 2,670 ft.

J. Earle Gray 1-B Logan, TE&L Sur. 2448. Dry. TD 1,298 ft.

Hale Bros. and Lion Oil Co. 2 Stovall, TE&L Sur. 732. Dry. TD 3,019 ft.

M & S Drilling Co. 2 Manning, Blk. 6, TE&L Sur. 3412, A-1232. IP 30 BOPD, 12/64-in., Strawn 3,088 ft. TD 3,098 ft.

C. W. Roberson 1 Davis, Blk. 66, TE&L Sur. Dry. TD 1,089 ft.

WEST TEXAS

Garza County: Clifton Thomas 1 Shelton, 1-A-H. G. Brandon Sur. Dry. TD 3,471 ft.

Hale County: E. W. Aylesworth 2 Bier, 1-D14-GC&SF. Dry. TD 3,662 ft.

Kent County: J. A. Lavender 1 Wallace, 91-G-W&NW. Dry. TD 7,569 ft. Elev. 2,346 ft. Strawn 7,160 ft.

Lamb County: Geo. P. Livermore 1 Kraushear, 17-660-State Capitol Lands. Dry. TD 4,406 ft.

Loving County: Lawless Drilling Co. 2 Kyle, 14-55-T1-T&P. Dry. TD 4,080 ft. Elev. 3,014 ft., Delaware sand 4,029 ft.

Martin County: Stanolind Oil & Gas Co. 1 Davenport, 14-34-T3N-T&P. Dry. TD 9,944 ft. Elev. 2,796 ft., Ellenburger 9,343 ft.

Pecos County: G. D. Putnam & Co. 1-B Woodward, 33-11-H&GN. IPP 92 BOPD, 36°, Tubb 2,904 ft. TD 2,975 ft.

Reagan County: Dixilyn Drilling Co. 1 University 5-49. 4-49 University Lands. Dry. TD 2,645 ft.

Reeves County: DeKalb Agricultural Association 1 Mandell, 2-4-H&GN. Dry. TD 4,827 ft. Elev. 2,623 ft., Delaware sand 4,381 ft.

Runnels County: Slick Moorman Production Co. 1 Vernon Webb, A. Lessassier Sur. 174. IPP 32 BOPD, 43°, pay 3,399 ft. TD 4,116 ft.

Scurry County: The Texas Co. 7 Fuller, 604-97-H&TC. IPP 7 BOPD, 32°, pay 2,548 ft. TD 2,700 ft.

Sutton County: Stanolind Oil & Gas Co. 2 Wallace, 49-14-TW&NG. Dry. TD 6,556 ft. Elev. 2,250 ft., Strawn 5,049 ft., Ellenburger 6,450 ft.

Ward County: Bentley & Adams 1 Monroe, 15-5-H&TC. Dry. TD 2,710 ft.

SOUTHEAST NEW MEXICO

Lea County: H. S. Moss 1 Lowe, 34-12s-37e. Dry. TD 12,387 ft. Elev. 3,907 ft., Pennsylvanian 9,600 ft., Mississippian 12,245 ft., Devonian 12,295 ft.

ILLINOIS

Christian County: M. H. Richardson 1 Brown, NW SW NW 12-15n-1w. Dry. TD 1,973 ft.

Cumberland County: H. F. Robison 1 Dix, NW NE NE 2-10n-7e. Dry. TD 2,220 ft.

Jasper County: Sanders & Fye 1 Wyatt, NE NE NE 6-7n-10e. Dry. TD 2,793 ft.

Madison County: George Cassens 1 Muelder Bros., SE NW NE 5-5n-6w. Dry. TD 606 ft.

J. Kesl, Jr. 1 Wetzel, SW SW SE 12-5n-6w. Dry. TD 815 ft.

Montgomery County: Calvert Drilling Co. 1 Huber, SW SE NW 9-7n-2w. Dry. TD 2,463 ft.

Washington County: A. M. Fowley 2 Ochs, SE NE SW 3-1s-4w. Dry. TD 2,360 ft.

White County: E. F. Moran 1 Lamont, NW NW NW 31-3s-10e. Dry. TD 3,450 ft.

Indiana Farm Bureau 1 Wright, NW NE SW 15-5s-10e. Dry. TD 3,140 ft.

INDIANA

Perry County: H. H. Vickers 1 Dauby, NE SE SW 12-6s-3w. Dry. TD 1,501 ft.

Pike County: C. L. Trussler 1 Jones, SE NE SE 3-1s-7w. Dry. TD 1,850 ft.

Sullivan County: O. A. Thayer 1 Wm. Jewell estate, NW NE NE 21-8n-10w. Dry. TD 922 ft.

WESTERN KENTUCKY

Daviess County: Stanley Lambert 1 Waitman, WL SW NE NE 6-P-29. Dry. TD 1,505 ft.

Hancock County: I. C. Huff 1 Powers, W½ NW NW SW 6-P-34. Dry. TD 796 ft.

Logan County: F. S. Stephenson et al 1 Marshall, SE SW SW SE 1-E-32. Dry. TD 1,903 ft.

McLean County: J. R. Sargent 1 Riggs, N½ NE SW SE 2-M-27. Dry. TD 1,921 ft.

MICHIGAN

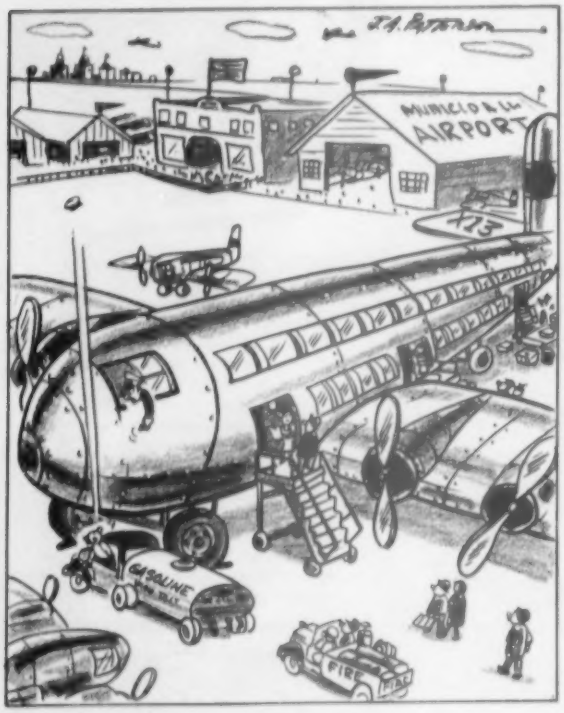
Allegan County: Merrill Drilling Co. 1 Arndt, SE NE SW 2-3n-13w. Traverse lime 1,688 ft., pay 1,690-91 ft., IPP 60 BOPD, TD 1,691 ft. (New pool.)

Kalamazoo County: Cook Drilling Co. 1 Parker, NE SE NE 35-3s-12w. Dry. TD 1,224 ft. in Traverse lime.

Midland County: The Dow Chemical Co. 1 Melchi, SE SE SE 36-14n-1e. Dry. TD 4,416 ft. in Detroit River "sour zone."

Oceana County: John Neyer 2 Ellis, NW SE

(Continued on page 246)



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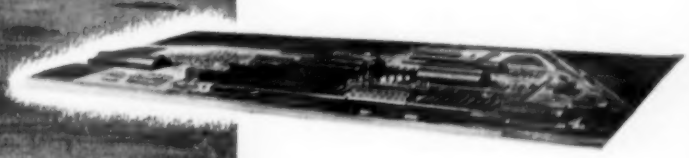
Another of 15 reasons why **REED** tool joints last longer!

"TAILORED" HEAT TREATMENT

FROM this control room, the heat treat foreman "tailors" the treatment of each batch of **REED** Tool Joints to fit the exact physical characteristics of the heat of steel from which they are made.

This "tailored" heat treatment results in tool joints that are tougher, safer and longer wearing than they would be if standard AISI specifications were used for all heats.

Such extras as "tailored" heat treatment are extra trouble for **REED** production and inspection departments—but they are important reasons why **REED** Tool Joints have the strength, toughness and wear resistance to give longer life with safety.

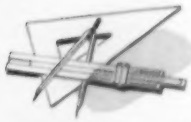


PESA

REED ROLLER BIT COMPANY

HOUSTON 1, TEXAS

15 reasons why REED tool joints last longer!



Advanced design. The list of **REED** tool joint developments is assurance that **REED** Tool Joints contain all the latest improvements in design.

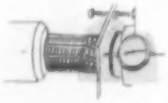
Chemical analysis of every heat of steel is checked by spectrograph.

Strength and toughness of every heat of steel are determined by three different testing machines.

Grain structure and grain flow are checked by microscope. **REED** Tool Joints meet the very highest standards.

Hardenability tests are made and form the basis for the "tailored" heat treatment of tool joints made from different heats of steel.

Precision machining is accomplished by specially designed automatic machines.



Jigs and fixtures of the highest precision assure perfect alignment and concentricity of **REED** Tool Joints.

Thread comparator checks hob used to cut **REED** Tool Joint threads, assuring accuracy of thread form, lead and taper.

Automatic heat treating furnaces—especially designed for the job—heat tool joints to utmost precision in a carefully controlled atmosphere.

This control control room enables the heat treat foreman to "tailor" the treatment of each heat of steel to extreme accuracy.

Precision quenching and drawing complete the "tailored" heat treatment that gives the best combination of strength and toughness to every tool joint.

Hardness testing is final assurance that every **REED** Tool Joint is strong and tough.

Tool joint threads are treated to prevent galling during breaking-in. Complex metal phosphate coating acts as a pre-lubricant infused into the threads.

"Reedite" hard facing—available on order—is factory applied to resist abrasion better and make tool joints last longer.

These hand gauges, plus comparators, master gauges, profilimeters, magnaflux and other machines, are used to make the 120 inspections each tool joint must pass.

REED ROLLER BIT COMPANY

HOUSTON 1, TEXAS

Up the Ladder

Pure boosts J. P. Langfitt to executive vice president

IT'S a long climb from a laborer to executive vice president of a major oil company, but that's how far J. Porter Langfitt has advanced during his 29 years with Pure Oil Co.

His move from senior vice president followed the election of Robert L. Milligan to the presidency of Pure.

Langfitt has been with Pure since being graduated in 1924 from Lehigh University at Bethlehem, Pa., as a mechanical engineer.

His first assignment with Pure was as a laborer at its refinery at Marcus Hook, Pa. Soon he became a construction engineer and then a stillman. A year after joining the company he was transferred to its Chicago headquarters, where he worked in the distillation department.

Vice president since 1947 . . . A roving assignment as assistant process engineer made him familiar with all of Pure's refineries. The knowledge and experience he gained on this assignment resulted in his being appointed assistant to the vice president in charge of refining operations in July 1937. Ten years later he moved up to vice president in charge of refining operations.

Last July he relinquished his responsibilities as supervisor of refining operations after being in charge of them for nearly 16 years. With this change he assumed general administrative responsibilities on a company-wide basis. However, he continued to direct the activities of the company's research and development laboratories, and the patent and engineering departments.

Langfitt devotes part of his spare time to his alma mater. He's an officer in the Lehigh University Alumni Association, and a member of the Committee on Business and Industry of the Lehigh Development Program. He's also a member of the Lehigh Club of Chicago.

Professional activities also attract his interest. He's a director of the Western Petroleum Refiners Association and a member of the American Petroleum Institute, and the American Society for Testing Materials.

The new executive vice president and director, a native of West Virginia, makes his home in Winnetka, Ill. His two daughters are students at Wells College in Aurora, N. Y.

Robert L. Milligan, executive vice president since 1951, has been elected president of Pure Oil Co. Chicago. He succeeds **L. S. Wescoat,** who has become chairman of the executive committee after 7 years as president. Milligan joined Pure in 1929, became treasurer in 1947, and 2 years later became a vice president. In 1952 he was elected to the board and in 1953 became a member of the executive committee. Wescoat, with Pure since 1925, also is a director.

R. L. MILLIGAN

L. S. WESCOAT

Joe Nuchia, formerly assistant district foreman for Sun Pipe Line Co. in the Premont, Tex., district, has been transferred to Sun Oil Co.'s storage and delivery department as chief gager. **Arthur L. French,** formerly assistant district foreman in the Snyder district, will replace Nuchia. Replacing French as assistant district foreman in the Snyder district will be **James E. Smith,** formerly area clerk in the Gulf Coast area office at Beaumont. **Edward R. Hewitt** has been transferred from the Dallas to the Corpus Christi geological staff. **Donald K. Lawrence,** petroleum engineer, has been transferred from the Longview area to the Odessa area. **Edgar Miller, Jr.,** has been named assistant chief gager of Sun Pipe Line Co.'s crude-lines department at Beaumont, effective on the completion of a present temporary assignment.

Jack L. Rune has been named director, vice president and executive assistant to the operating head of Champlin Refining Co., Enid, Okla. He formerly was Rocky Mountain regional manager for The Chicago Corp., which recently purchased Champlin and its subsidiary, Peppers Refining Co. Rune, with The Chicago Corp. since 1944, will be executive assistant to **G. E. Leverton,** veteran Champlin comptroller who has been named vice president in charge of operations.

JACK L. RUNE

J. K. Butler, Houston, has been elected a director and vice president of Fifteen Oil Co. He is president of Oil Production Maintenance, Inc.

Elliott G. Flowers has been promoted to administrative assistant to the president of Union Sulphur & Oil Co. He has been with the company 2 years.

Thomas Arthur, drilling superintendent of Assam Oil Co., Ltd., Digboi, India, has retired after 28 years with the company in the East. Last year he was driller-in-charge of the A.O.C. deep well at Nahorkatiya on the edge of the Brahmaputra Valley which resulted in discovery of oil in the area. Arthur, a native of Scotland, plans to live in Brisbane, Australia.

Frank A. Morgan has resigned as vice president and manager of exploration of Richfield Oil Corp., effective early in June. Morgan plans a trip to Alaska following his resignation. He intends to remain in the oil industry, possibly as an independent consultant. Morgan held the two posts since formation of the company in 1937. Prior to that, he was chief geologist for Rio Grande Oil Co., which he joined in 1929.

Walter T. Jameson has been appointed superintendent of the Santa Maria refinery which Union Oil Co. of California plans to build in San Luis Obispo County, California. He joined Union Oil in 1940 and has been assigned to the firm's Cut Bank, Mont.,

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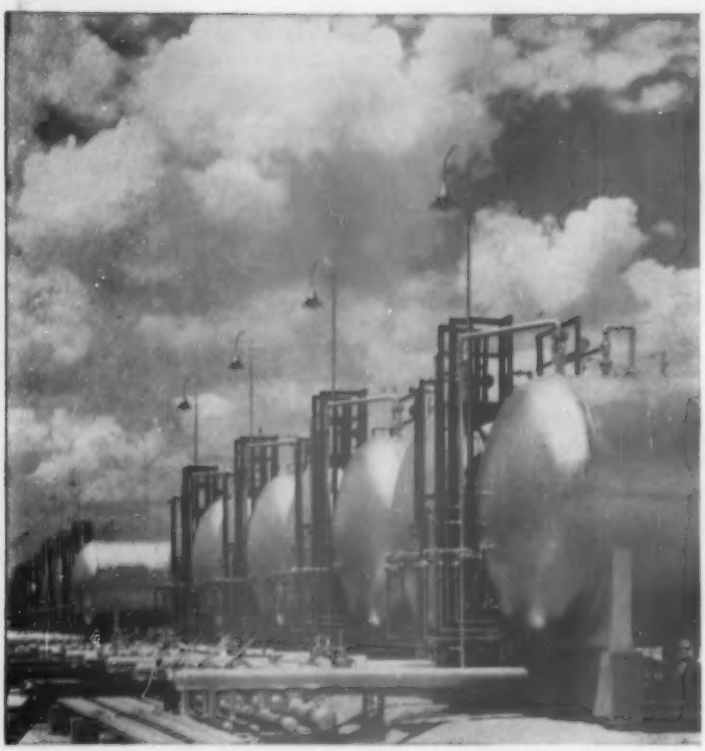

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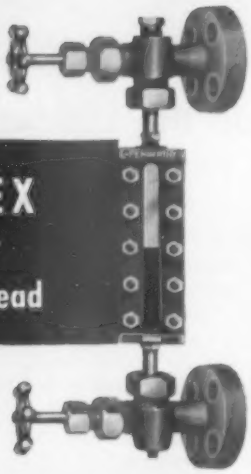

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PERSONALS

Oleum, and Los Angeles refineries. Most recently he has been assistant superintendent of the operations department at the Los Angeles refinery.

T. J. Hanley, Phillips Oil Co., Venezuela, has been transferred from San Roque field to Mata Grande as district foreman. **G. W. Wilson** has been promoted from district foreman at Mata Grande to drilling superintendent at Bella Vista. **L. H. Kaplan,** geologist, formerly with Phillips in Venezuela, has joined Pan Israel Oil Co., Inc., to head the exploration program which that company is undertaking in Israel.

B. R. Fraser has been promoted by Vacuum Oil Co., Ltd., from assistant manager to manager at its refinery at Coryton, England. He replaces **D. M. Glendinning,** who has resigned. **J. W. Bartholomew** has been advanced from superintendent of the operating division to assistant manager (process). **W. Kohring** has been moved up from superintendent of engineering division to assistant manager (engineering), and **H. T. Fuller** advanced from adviser to refinery management to superintendent of operating division.

Dr. Ezak Swemle has retired after 27 years with the Shell organization. He was chief geologist for Shell in Colombia and formerly held the same position in Ecuador.

J. A. MIDDLETON

L. D. STEWART

P. M. REYNOLDS

James A. Middleton and **Laron D. Stewart** have been promoted by Mid-Continent Petroleum Corp., Tulsa, to the new positions of assistant general refinery superintendents, mechanical section and process section, respectively. Middleton has been chief engineer at the firm's Tulsa refinery since 1946. **Pierce M. Reynolds** has succeeded Stewart as chief process engineer, the position he had held since 1951. Reynolds joined Mid-Continent in 1948 and was made senior process engineer in 1950.

Robert E. Chancellor, formerly geologist for Shell Oil Co. in Texas and the Rocky Mountain region, has joined **Cortlandt S. Dietler,** Denver independent.

F. M. Files has been transferred by Phillips Petroleum Co. from Salt Lake City to McGregor, Tex., as manager of manufacturing at Air Force plant No. 66, operated by the rocket-fuels division of the company's research and development department. **George F. L. Bishop,** previously superintendent of the Phillips refinery at Okmulgee, Okla., has replaced Files as northwest division refining superintendent at Salt Lake City. **L. H. Vautrain,** assistant superintendent of the Phillips refinery at Sweeny, Tex., has replaced Bishop as superintendent of the Okmulgee refinery.

Earl B. Baldridge, Fort Worth, has been elected president of The Chicago Corp., succeeding **Richard Wagner,** who has become chairman of the board and chief executive officer. Baldridge, formerly executive vice president of the firm, also is president of Champlin Refining Co. and chairman of the board of Peppers Refining Co. Wagner had been president since 1938 and is chairman of the Champlin board. **Charles B. Johnson, Jr.,** also has been elected vice president in charge of production operations and **Ira H. Stein** has been named vice president in charge of land and exploration. Both had been manager of their respective departments.

E. R. BALDRIDGE

R. WAGNER

W. Ward Jackson has been named a vice president of Commercial Solvents Corp., New York, and will direct the firm's petrochemicals division. He succeeds **Abbott K. Hamilton,** who has resigned.

V. J. Nolan, independent producer, Mount Vernon, Ill., has been reelected president of the Illinois Oil and Gas Association. Other officers named by the association at its ninth annual meeting include: **David R. Stewart,** Moses & Stewart, Mattoon, Ill., first vice president; **E. J. Reading,** Sun Oil Co., Evansville, Ind., second vice president; **E. A. Davenport,** Shell Oil Co., Centralia, Ill., third vice president; **E. B. Stewart,** Ohio Oil Co., Terre Haute, Ind., secretary;

Magnolia Presents 40-Year Pin to John W. Newton

John W. Newton, left, vice president and manager of refining for Magnolia Petroleum Co., receives a service pin emblematic of his 40 years with Magnolia from J. L. Latimer, company president. The presentation was made at a luncheon given in Newton's honor at the Dallas Petroleum Club. Newton also is vice president and chairman of the Division of Refining of the American Petroleum Institute.

PERSONALS

C. R. Collins, Collins Bros. Oil Co., Mount Vernon, treasurer; **C. T. Smith,** independent producer, Flora, Ill., general counsel; and **Charles J. Pardee,** Mount Vernon, executive secretary.

J. B. KENNEDY

Joseph B. Kennedy, Tulsa, and **C. W. Horstmeier,** Denver, have been elected vice presidents of Sinclair Oil & Gas Co. Kennedy, who has been with the company 19 years, will continue in charge of the acquisition of producing properties. Horstmeier will be vice president in charge of oil exploration in the Rocky Mountain area. He joined the firm in 1917 and for about the last 2 years has been in Denver as division land manager and head of exploration.

John M. Kindle has been promoted by Lone Star Gas Co., Dallas, from superintendent of gasoline plants to superintendent of transmission operations. **Chester R. Roger,** formerly assistant superintendent of gasoline plants, has replaced Kindle. **Carl M. Hill,** superintendent of production, has been named superintendent of exploration and gas supply operations. **M. O. Attebery** has been advanced from assistant superintendent to superintendent of production, replacing Hill.

Robert H. Colley has retired as chairman of the board of Atlantic Refining Co. He continues as a member of Atlantic's board. Colley, in the oil industry more than 48 years, joined Atlantic in 1919 and became president in 1937. For several years he was a director and member of the executive committee of the American Petroleum Institute and was elected an honorary life director at its last annual meeting.

J. G. Wilson, formerly chief engineer at Shell Oil Co.'s refinery at Wood River, Ill., has been appointed manager of the manufacturing engineering department at the company's head office in New York. He succeeds **W. F. Court,** who has retired after 30 years with the firm. Wilson joined Shell in Mexico in 1933 and was made chief engineer at Wood River in 1952.

Ray L. Herrington has been promoted by United Gas Pipe Line Co. from assistant chief dispatcher for the Dallas district with headquarters at Carthage, Tex., to Shreveport as chief dispatcher for the district. **Barney B. Dokey** also has been promoted by United Gas from chief engineer at the Sarepta compressor station to the same position at the Koran compressor station. **Obie L. Bush,** formerly chief engineer at the Iowa compressor station in the Southwest Louisiana district, has replaced Dokey.

Morris M. Slotnick has joined Standard-Vacuum Oil Co. as geophysical consultant and advisor for the firm's exploration activities in the Far East, with headquarters in New York. He joined Humble Oil & Refining Co. in 1930 and from 1936 until early this year was chief mathematician in the company's exploration department in Houston.

S. J. STACEY

Sidney J. Stacey has been appointed assistant to the president of California Texas Oil Co., Ltd. He will deal principally with company operating expenses and capital investments. **D. L. McCarroll** has been advanced from assistant comptroller to comptroller, replacing Stacey.

Joseph W. Meehan has been elected president of Pure Transportation Co., a wholly owned subsidiary of Pure Oil Co. Meehan will continue in Chicago as general manager of pipelines and the crude-oil purchasing division of Pure Oil.

DEATHS

F. C. Hall, 76, independent producer, died recently in Oklahoma City following an operation. His first venture in the oil business was in 1913 in the Chickasha and Cement fields in Oklahoma. He later was active in Oklahoma City field and in various West Coast fields. Hall also was a leader in aviation. He financed Wiley Post's 1931 record-breaking flight around the world and backed entries in the Bendix Trophy Air Race and others.

William G. Johnston, 62, Oklahoma City independent, died May 3 in Denver following a heart attack suffered at the silver anniversary meeting of the Independent Petroleum Association of America. He was a former director of Sunray Oil Corp. and had been active in politics for several years.

Sherman N. Shumway, 59, vice president and a director of Signal Oil & Gas Co., Los Angeles, died recently at Soboba Hot Springs, Calif., following a heart attack. He was recuperating after a recent illness.

I. H. Patton, Jr., 69, president of Arrow Drilling Co., died recently in Tulsa following a heart attack. He helped organize the old Arrow firm in about 1924 and joined the present firm as vice president in 1931. In 1948 he became executive vice president and was named president in March when the company was purchased by a New York group.

Sylvester Yunker, 61, Owensboro, Ky., independent producer, died recently in Louisville, Ky., following a stroke. Since 1949 he had been Gov. Lawrence W. Wetherby's representative on the Interstate Oil Compact Commission. Yunker entered the oil business in 1934 in Owensboro and was one of the first to introduce water flooding in that area. He also had been a director of the Independent Petroleum Association of America, Kentucky Oil and Gas Association, and National Oil Scouts and Landmen's Association.

Arthur J. Slagter, Sr., 72, retired manager of refineries for the old Transcontinental Oil Co., Tulsa, died recently in Evansville, Ind. He acted as a co-manager of the refineries for a while after they were taken over by Ohio Oil Co. in 1930.

Ralph C. Bromwell, 55, pioneer California oil man, died recently in Santa Barbara, Calif. He was credited with bringing in the discovery well at Santa Fe Springs and some of the first wells in the Signal Hill field.

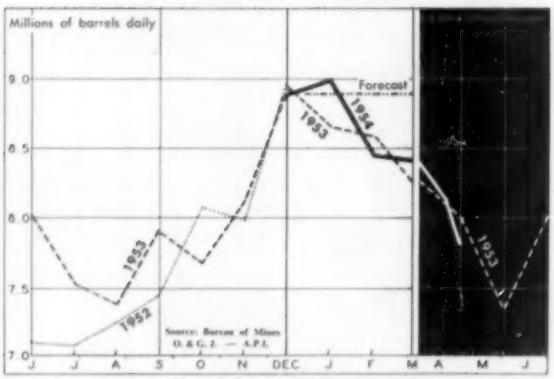
Frank Bigelow, 77, retired executive of the Latin American affiliates of Standard Oil Co. (N. J.), died recently in Summit, N. J., following a heart attack. He joined Jersey Standard in 1891 and at the time of his retirement in 1936 was vice president of Esso Standard Oil Co. of Cuba, Creole Petroleum Corp., and Lago Oil & Transport Co., Ltd.

Latest Figures . . . Industry Trends

A QUICK LOOK AT THE HIGHLIGHTS

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	6,614,825	UP	9,250	UP	339,300
Crude stocks	269,647,000	UP	1,451,000	DOWN	8,495,000
Completions	1,012	UP	23	UP	32
Refinery runs	6,675,000	DOWN	137,000	DOWN	274,000
Four-product stocks	301,726,000	UP	2,444,000	UP	25,635,000
Total imports	778,600	DOWN	243,400	DOWN	223,800

TOTAL DEMAND—ALL OILS



Seasonal Changes in Product Demand Bring Shifts in Product Prices

DISTILLATE and kerosine prices have eased on East Coast and Gulf Coast markets, following some dropoff in the demand at the end of the heating season.

Esso Standard Oil Co. announced reductions for kerosine and light distillates for its marketing area on the East Coast at the end of April. Formal postings for barge delivery of No. 2 fuel during April was 9.4 cents per gallon, but suppliers credited a voluntary allowance of 0.2 cent a gallon for a net of 9.2 cents. The new posted barge price for No. 2 fuel in New York Harbor is 8.95 cents a gallon. The same reduction for kerosine brought the barge price down to 9.95 cents. Tank-wagon prices for heating oils were cut. Kerosine is off 0.4 cent a gallon and No. 2 off 0.5 cent.

Price protection for customers who fill their storage tanks during the summer months has been reported for marketing areas in the northeastern states. Some suppliers feel that price protection will do more to get resellers and consumers to fill their tanks early in the summer than a flat discount. The response to summer-fill discounts last year was disappointing in some areas.

Lower Gulf Coast prices . . . Some softening of the Gulf Coast heating-oil market has been reported for several weeks without definite confirmation of sales at the lower figures. Low quotations of suppliers on the Gulf Coast now range from 8.0 to 8.25 cents a gallon for No. 2 fuel. Spot quotations for kerosine range from 9.0 to 9.25 cents for cargo movement.

Clean-tanker rates for the Gulf-East Coast movement are reported to be about 40 per cent off the Maritime Commission base rate. At this rate, No. 2 fuel can be moved to the East Coast for about 0.55 cent a gallon plus insurance and terminal charges.

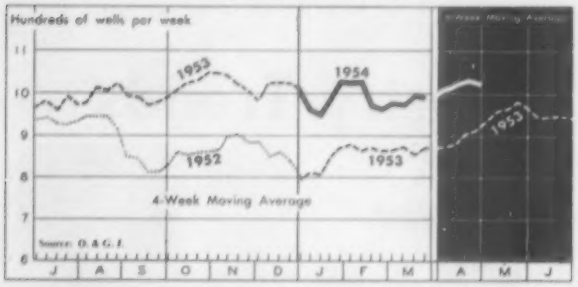
Natural gasoline strengthens . . . Natural-gasoline prices were subnormal in April. Suppliers and purchasers agreed that the general natural-gasoline market was not as soft as the low price indicated. Some distress material tended to set the market at a level lower than was justified on a basis of demand.

Grade 26-70 natural moved back up 0.5 cent a gallon, effective April 30. This increase brought the Group 3 price up to 4.5 cents and the North Texas price to 4.0 cents.

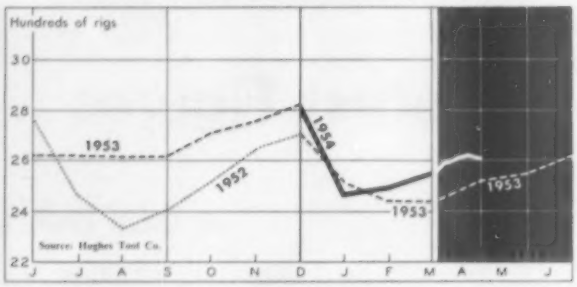
Any further increases in natural-gasoline prices within the next 2 months will depend on the demand for motor fuel. Present data indicate that the motor-gasoline stocks may be above the desired level at the end of June. If this is the case, little additional improvement in the natural-gasoline market can be expected before the normal upturn early in the fall.

Some pressure on gasoline prices has been maintained by some suppliers who have tried to rush the motoring season. April is normally a transition month for gasoline sales.

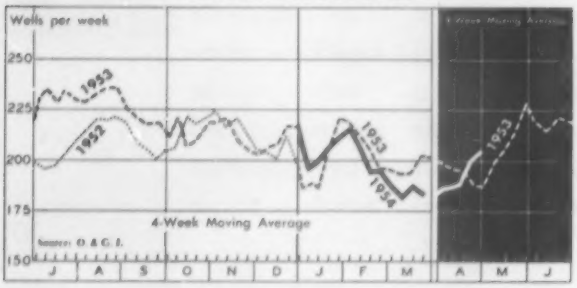
TOTAL COMPLETIONS



ROTARY RIGS OPERATING IN UNITED STATES



WILDCAT COMPLETIONS



ACTIVE ROTARY RIGS

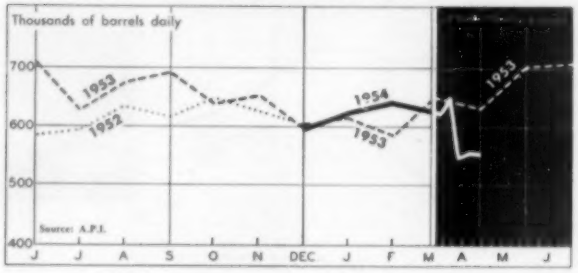
Area—	5-3-54	Change from 4-26-54	Change from 5-4-53
Gulf Coast	566	— 3	—50
N. and W. Texas-New Mexico	805	3	7
Arkansas-N. Louisiana-E. Texas	191	5	71
Oklahoma	356	—10	8
Kansas-S. Nebraska	163	10	—25
Illinois-Eastern	126	—16	5
Rocky Mountain	254	— 7	29
Pacific Coast	140	— 1	—28
Total United States	2,601	—19	17
Western Canada	127	—14	—15

WEEKLY WELL COMPLETIONS . . . WEEK ENDED MAY 1, 1954

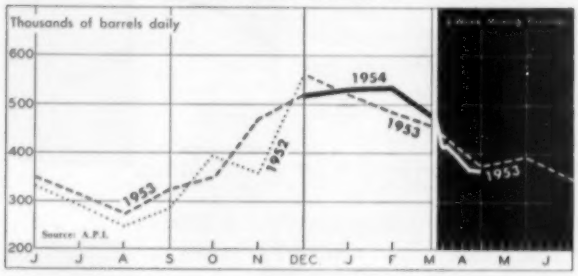
	Total of all wells: Comp.	Oil	Gas	Dry	Footage	Cum. 1954	Cum. 1953	Wildcat completions and discoveries: Oil	Dist.	Gas	Dry	Total	Cumulative total, 1954: Oil	Dist.	Gas	Dry	Total
Ala.-Ga.-Fla.	1	0	0	1	5,274	40	46	0	0	0	1	1	2	0	1	33	36
Arkansas	13	4	0	9	52,574	234	156	0	0	0	2	2	8	0	2	35	45
California	54	37	2	15	265,657	828	854	1	0	1	13	15	27	1	6	177	211
Colorado	25	13	1	11	142,442	395	166	0	0	0	7	7	13	0	0	138	151
Illinois	66	38	0	28	164,056	871	543	0	0	0	9	9	2	0	0	146	148
Indiana	14	7	0	7	25,652	259	391	0	0	0	3	3	3	0	0	62	65
Kansas	78	43	6	*29	269,671	1,473	1,629	0	0	1	14	15	25	0	7	193	225
Kentucky	29	8	9	12	71,023	362	332	0	0	0	4	4	7	0	0	40	47
Louisiana	56	41	3	12	321,915	1,090	870	4	1	1	4	10	35	20	12	90	157
North	30	20	2	8	83,969	588	358	0	0	0	3	3	5	0	3	35	43
South	26	21	1	4	237,946	502	512	4	1	1	1	7	30	20	9	55	114
Michigan	11	3	0	8	25,253	187	174	1	0	0	5	6	4	0	0	80	84
Mississippi	5	3	0	2	37,807	126	118	0	0	0	1	1	2	0	0	45	47
Montana	5	2	0	3	16,920	94	128	0	0	0	1	1	1	0	0	27	28
Nebraska	5	2	0	3	25,988	113	92	0	0	0	3	3	8	0	0	33	41
New Mexico	17	7	7	3	102,926	379	447	0	0	0	1	1	7	0	3	50	60
North Dakota	8	5	0	3	56,060	78	81	0	0	0	3	3	3	0	0	24	27
Ohio	22	8	2	12	41,130	368	344	0	0	0	0	0	0	0	2	5	7
Oklahoma	170	104	3	†63	524,245	3,136	2,352	2	0	0	15	17	42	2	8	204	256
Pennsylvania-New York	45	22	3	‡20	76,797	807	769	0	0	0	0	0	0	0	3	10	13
Texas	366	220	14	132	1,681,290	5,998	5,653	13	1	3	89	106	240	27	54	1,357	1,678
Southwest (1 & 4)	64	38	2	24	303,563	872	899	2	1	0	15	18	24	16	14	238	292
Gulf Coast (2 & 3)	52	26	4	22	346,027	919	834	0	0	2	17	19	26	9	15	222	272
East (5 & 6)	13	6	2	5	74,438	291	271	0	0	0	4	4	6	0	6	78	90
North Central (7-B & 9)	145	81	3	61	479,389	2,258	2,093	8	0	1	41	50	116	2	8	561	687
West (7-C & 8)	77	58	2	17	428,769	1,350	1,258	3	0	0	10	13	68	0	7	234	309
Panhandle (10)	15	11	1	3	49,104	308	298	0	0	0	2	2	0	0	4	24	28
Utah	0	0	0	0	0	22	24	0	0	0	0	0	2	0	0	13	15
West Virginia	5	0	3	2	8,578	182	182	0	0	0	0	0	0	0	8	5	13
Wyoming	16	12	1	3	77,765	496	202	0	0	1	1	2	17	0	3	64	84
Miscellaneous (Ariz.)	1	0	0	1	6,490	76	16	0	0	0	1	1	1	0	0	10	11
Total United States	1,012	579	54	379	3,999,513	17,614	15,569	21	2	7	177	207	449	50	109	2,841	3,449
Total previous week	989	559	58	372	3,770,610			24	2	7	178	211	428	48	102	2,664	3,242
Total May 2, 1953	980	531	98	351	3,930,229			22	2	12	138	174	456	32	119	2,845	3,452

Service wells included: *1, †10, ‡18.

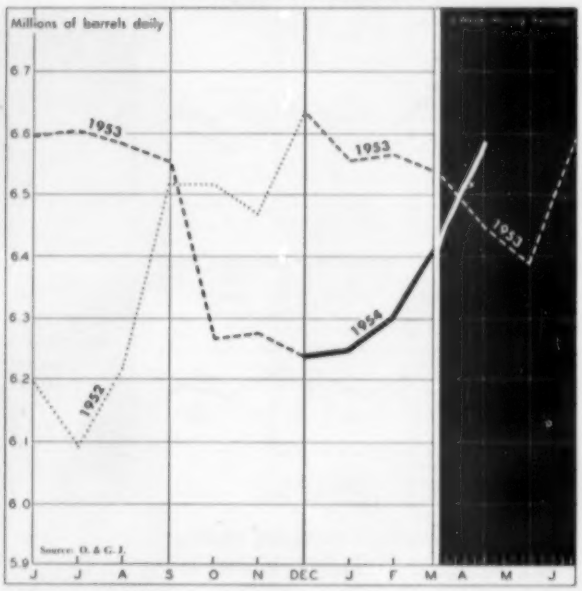
CRUDE IMPORTS



PRODUCT IMPORTS



CRUDE-OIL PRODUCTION

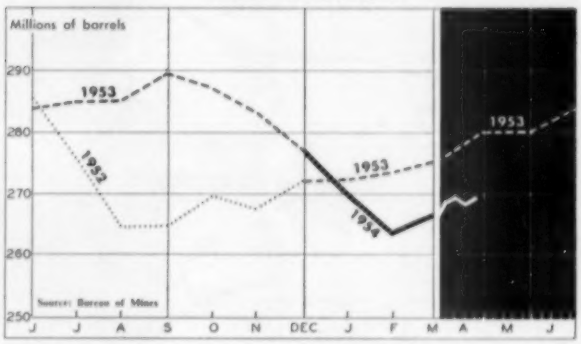


DAILY AVERAGE PRODUCTION FOR WEEK

	May 1 — Crude oil	May 1 — Lease condensate	May 1 — Total	April 24 total
Alabama	4,800	.....	4,800	4,700
Arkansas	77,050	550	77,600	77,750
California	987,100	.....	987,100	988,700
Colorado	126,200	.....	126,200	126,500
Eastern	54,500	.....	54,500	54,500
Florida	1,525	.....	1,525	1,525
Illinois	183,600	.....	183,600	180,400
Indiana	31,100	.....	31,100	30,900
Kansas	336,700	.....	336,700	329,900
Kentucky	35,400	.....	35,400	35,700
Louisiana	678,750	47,400	726,150	725,900
North	108,750	3,900	112,650	112,400
South	570,000	43,500	613,500	613,500
Michigan	34,500	.....	34,500	33,900
Mississippi	87,850	3,850	91,700	91,950
Montana	32,900	.....	32,900	34,800
Nebraska	20,100	.....	20,100	20,500
New Mexico	206,500	1,700	208,200	208,100
North Dakota	15,100	.....	15,100	14,900
Oklahoma	547,300	.....	547,300	†546,600
Texas	2,800,000	51,250	2,851,250	2,851,250
Dist. 1	41,500	425	41,925	41,925
Dist. 2	148,200	7,500	155,700	155,700
Dist. 3	433,000	24,250	457,250	457,250
Dist. 4	256,500	5,900	262,400	262,400
Dist. 5	48,000	450	48,450	48,450
Dist. 6	118,500	5,800	124,300	124,300
East Texas field	248,800	.....	248,800	248,800
Dist. 7-B	139,000	50	139,050	139,050
Dist. 7-C	184,000	4,750	188,750	188,750
Dist. 8	902,000	1,500	903,500	903,500
Dist. 9	194,000	600	194,600	194,600
Dist. 10	86,500	25	86,525	86,525
Utah	5,400	.....	5,400	5,500
Wyoming	243,700	.....	243,700	241,600
Total U. S.	6,510,075	104,750	**6,614,825**	†6,605,575
Change from previous week,			**up 9,250**	
Canada	186,925	.....	186,925	180,775
Total U. S. production January 1-May 1				†777,396,750 bbl.
Same period last year (crude plus cond.)				*789,123,590 bbl.

*Includes 11,356,550 bbl. condensate. †Revised Oklahoma figure—February 6-May 1.

CRUDE-OIL STOCKS



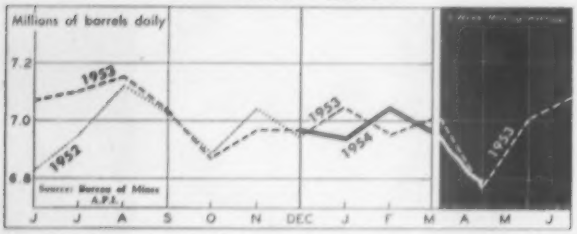
CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

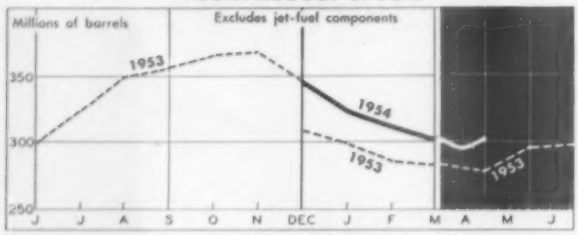
	Apr. 24, '54	Apr. 17, '54	Apr. 25, '53
Pennsylvania Grade	3,005	2,986	2,445
Other Appalachian	1,716	1,572	1,934
Illinois, Indiana, Michigan	12,254	12,099	10,748
Kansas	9,557	9,530	10,829
Oklahoma	26,471	26,686	28,448
Arkansas	3,497	3,166	3,050
Louisiana	15,717	14,763	16,202
North	2,481	2,477	2,737
Gulf	13,236	12,286	13,465
Mississippi	3,430	3,484	3,995
New Mexico	7,655	7,847	7,348
Texas	123,034	123,895	135,329
East Texas proper	10,808	10,764	11,753
West Texas	54,130	53,783	64,186
Texas Gulf	25,732	25,873	25,981
Other Texas	32,364	33,475	33,409
Wyoming	14,088	13,793	13,756
Other Rocky Mountain	3,786	3,797	2,613
California	34,113	34,408	33,316
Foreign	†11,324	10,170	8,218
Total	269,647	268,196	278,231

*Bureau of Mines. †Includes 2,418,000 bbl. in California.

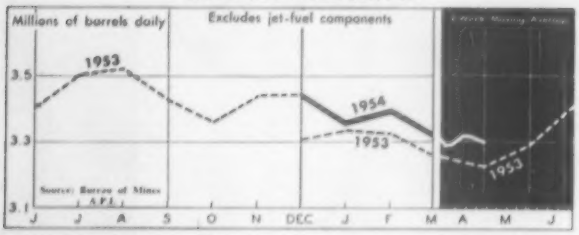
REFINERY RUNS



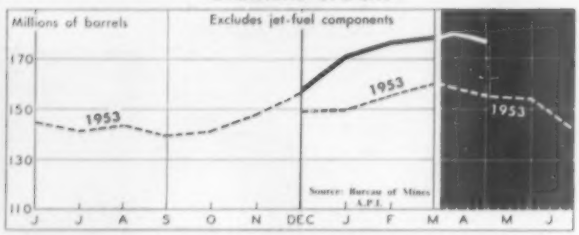
FOUR-PRODUCT STOCKS



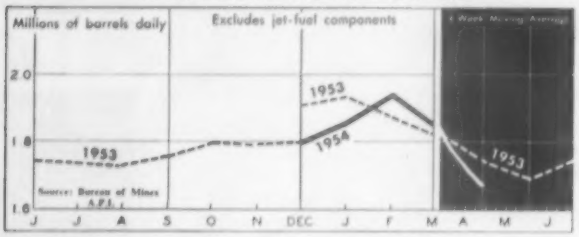
GASOLINE PRODUCTION



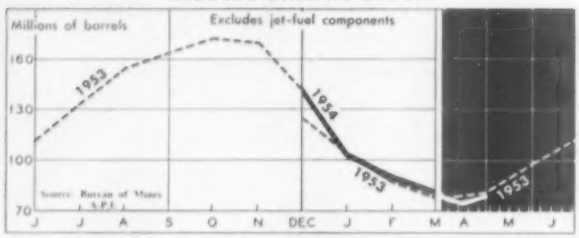
GASOLINE STOCKS



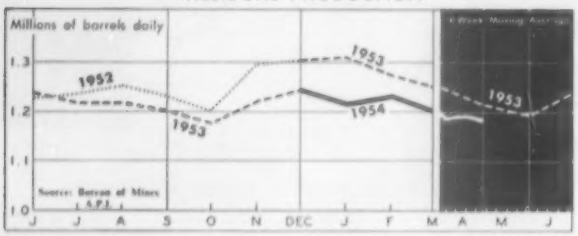
MIDDLE-DISTILLATE PRODUCTION



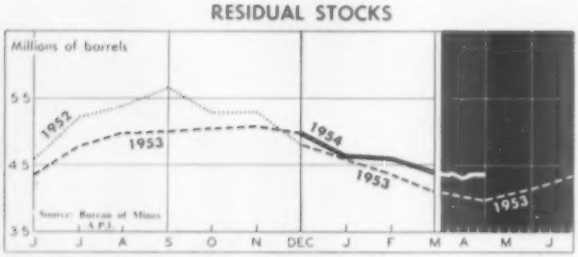
MIDDLE-DISTILLATE STOCKS



RESIDUAL PRODUCTION



RESIDUAL STOCKS



A.P.I. REFINERY REPORT, MAY 1

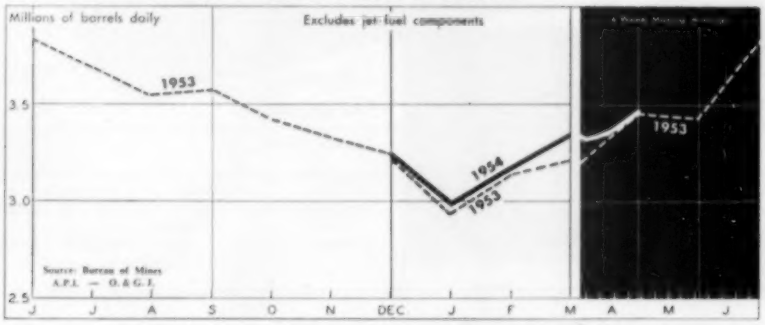
(Excludes all jet-fuel components)

(Thousands of barrels)

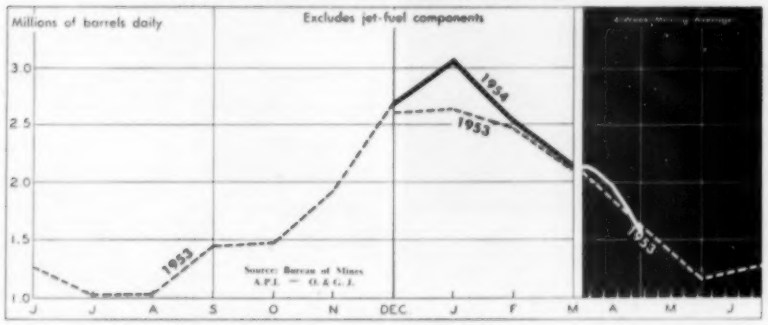
District—	Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.	Stocks‡ Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, April 1953 Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.
East Coast	1,044	392.6	40.6	221.3	195.1	37,322	8,194	19,800	8,883	997	385.2	44.5	227.6	229.3
Appalachian:														
District 1	79	30.1	4.2	16.8	4.1	4,393	397	1,069	543	104	41.7	4.7	20.5	14.7
District 2	94	45.8	3.6	17.8	12.7	2,629	282	620	423	80	44.0	4.8	14.3	13.9
Ind., Ill., Ky.	1,214	659.3	84.3	192.2	158.6	39,388	4,140	9,672	4,207	1,149	617.2	65.4	193.2	153.7
Okla., Kans., Mo.	519	320.4	13.4	109.6	44.7	19,367	1,085	7,294	1,258	556	310.6	17.8	121.2	54.5
Inland Texas	261	178.7	12.7	44.2	26.9	7,359	336	1,179	1,208	259	171.2	12.1	42.5	35.8
Texas Gulf Coast	1,638	768.9	81.4	346.6	242.3	23,006	2,438	6,448	4,226	1,726	793.0	131.3	409.6	248.2
La. Gulf Coast	506	248.9	61.4	122.4	46.7	8,832	1,891	2,750	1,052	553	267.6	41.0	149.2	55.5
N. La. and Ark.	67	25.8	6.0	20.7	6.1	3,995	439	991	170	86	34.1	8.5	20.6	7.1
Rocky Mountain:														
New Mexico	15	8.3	1.0	2.0	2.0	179		54	37	21	13.5	0.4	2.7	4.3
Other Rocky Mtn.	234	116.7	2.1	51.0	38.9	8,266	166	1,864	810	207	101.4	2.4	49.1	36.4
California	1,004	428.3	3.4	150.7	353.0	22,322	312	9,664	20,766	1,043	444.5	7.5	164.0	365.7
May 1, 1954	6,675	3,223.8	314.1	1,295.3	1,131.1	177,058	19,680	61,405	43,583	6,781	3,224.0	340.4	1,414.5	1,219.1
April 24, 1954	6,812	3,331.3	307.8	1,345.4	1,194.4	178,033	18,518	58,932	43,779	.....	.....	.....	.....	.....
May 2, 1953	6,949	3,272.1	361.7	1,420.3	1,208.1	156,391	19,624	61,087	38,989	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

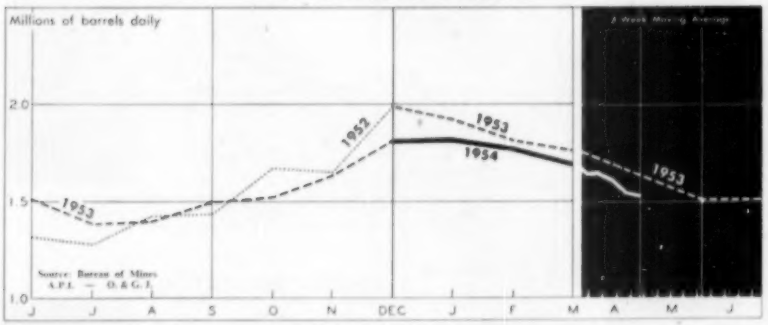
TOTAL GASOLINE DEMAND



TOTAL MIDDLE-DISTILLATE DEMAND



TOTAL RESIDUAL DEMAND



REPRESENTATIVE QUOTATIONS

Spot-market quotations of leading suppliers as of May 5, 1954. Prices are in cents per gallon, except for residual in dollars per barrel and wax in cents per pound.

GASOLINE, KEROSINE, AND FUEL OILS

	Mid-Continent Group 3	New York Harbor (barge)	Texas Gulf Coast
Regular gasoline	10.75-11	11.5-12.25	10.25-10.5
Premium gasoline	11.75-12	13.25-14	11.5-12.25
42-44 w.w. kerosine	9.125-9.375	9.95-10.2	9-9.25
No. 2 straw fuel oil	8.25-8.375	8.95-9.2	8-8.25
No. 6 residual	$1.00-1.20	$2.20-2.40	$1.85-1.95

NATURAL GASOLINE

	Group 3	North Texas	N. La.
Grade 26-70	4.5	4.0	4.25
Grade 18-55	5.4	4.9	5.15

LUBRICATING OILS

Mid-Continent

150-160 vis., D bright stock, 0-10 pp.	18
200 vis., No. 3 neutral, 0-10 pp.	13.25

WAX

Mid-Continent

132-134 A.M.P.	6.0

• Heating-oil prices on the New York Harbor market decreased 0.25 cent a gallon at the end of April. Cargo prices for heating oils on the Gulf Coast also dropped 0.25 cent. Natural gasoline increased 0.5 cent a gallon on April 30 to 4.5 cents for Grade 26-70 on the Group 3 market.

PRODUCTION AND DEMAND—MAJOR PRODUCTS

(Thousands of barrels daily)

	Refinery prod.	Total demand
Gasoline:		
Four weeks ended 5-1-54	3,299	3,484
February 1954	3,365	3,182
January 1954	3,354	2,985
April 1953	3,224	3,473
Middle distillate:		
Four weeks ended 5-1-54	1,665	1,540
February 1954	1,957	2,417
January 1954	1,857	3,076
April 1953	1,755	1,647
Residual fuel:		
Four weeks ended 5-1-54	1,185	1,532
February 1954	1,241	1,753
January 1954	1,271	1,831
April 1953	1,219	1,652

SUPPLY AND DEMAND*

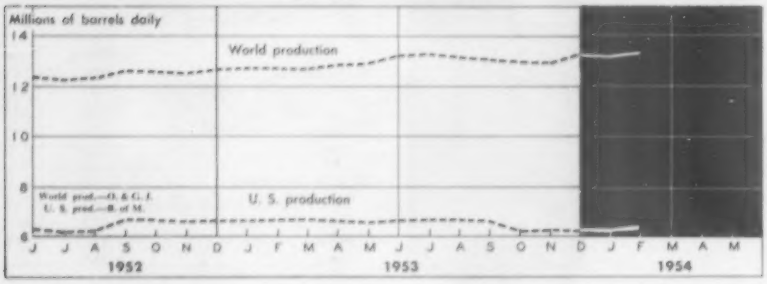
(Thousands of barrels daily)

	Feb. 1954	Feb. 1953
Domestic demand	8,123	8,117
Gasoline	3,079	3,031
Kerosine	453	479
Distillate	1,887	1,869
Residual	1,678	1,733
Jet fuel	124	81
Lubricants	97	105
L.P.G.	342	353
Other products	441	428
Crude loss	22	38
Exports	356	456
Gasoline	103	107
Kerosine	25	16
Distillate	53	135
Residual	75	70
Jet fuel		
Lubricants	47	25
L.P.G.	12	9
Other products	13	22
Crude	28	72
Total demand	8,479	8,573
Gasoline	3,182	3,138
Kerosine	478	495
Distillate	1,940	2,004
Residual	1,753	1,803
Jet fuel	124	81
Lubricants	144	130
L.P.G.	354	362
Other products	454	450
Crude exp. and loss	50	110
Stock change	—249	—286
Crude	—139	48
Products	—110	—334
New supply	8,230	8,287
Imports	1,144	1,067
Crude	621	586
Products	523	481
Production	7,086	7,220
Crude	6,379	6,562
Natural gasoline	707	658
Runs to stills	7,068	6,969

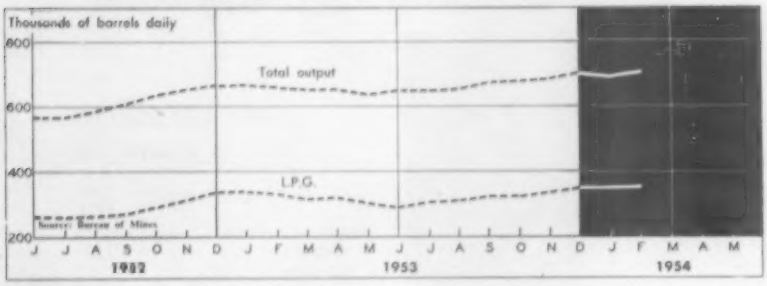
*Bureau of Mines.

(The schedule of selected crude prices appeared on page 178 of May 3 issue and will be printed again next week.)

CRUDE-OIL PRODUCTION



NATURAL-GASOLINE AND CYCLING-PLANT PRODUCTION



CRUDE PRODUCTION

(Thousands of barrels daily)

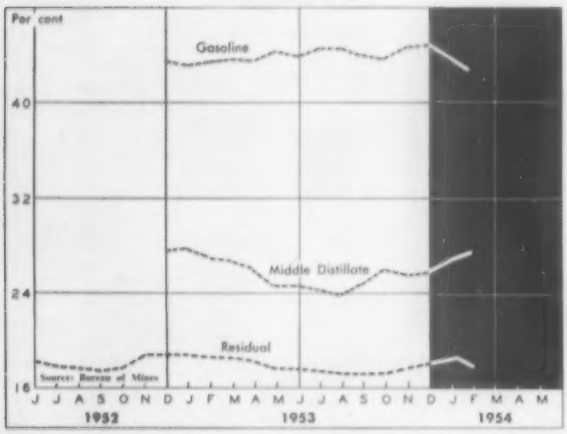
Month—	U. S.	World
February 1954	6,379	13,382
January 1954	6,240	13,168
December 1953	6,238	13,241
September 1953	6,557	13,157
February 1953	6,562	12,839

PRODUCTION AT NATURAL-GASOLINE AND CYCLING PLANTS

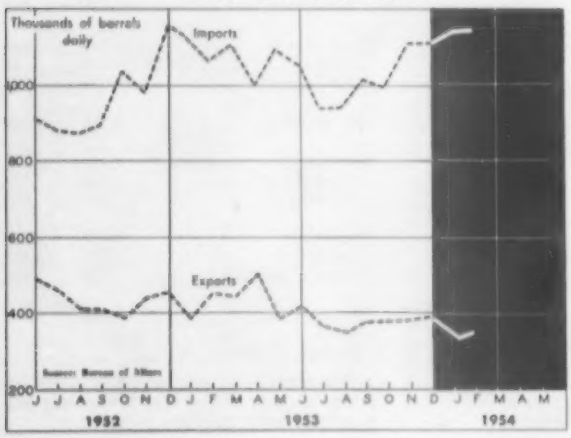
(Thousands of barrels daily)

Month—	L.P.G.	Total
February 1954	356	705
January 1954	355	688
December 1953	348	700
September 1953	317	674
February 1953	320	657

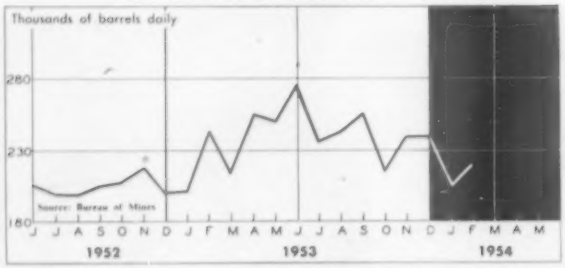
REFINERY YIELDS



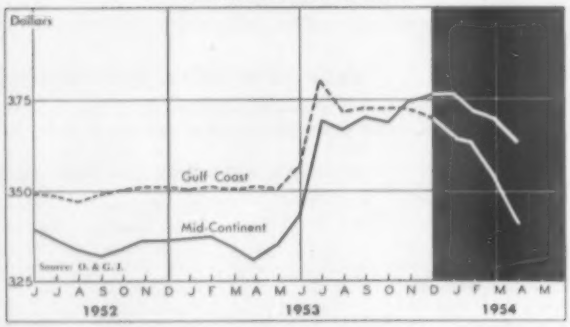
IMPORTS-EXPORTS



TOTAL DEMAND–AVIATION GASOLINE



REFINERY REALIZATION



REFINERY REALIZATION

	Apr. 1954	Mar. 1954	Apr. 1953
Mid-Continent	$3.63	$3.69	$3.31
Gulf Coast	3.40	3.56	3.51

Refinery realization is based on yields of major products and average spot prices for regular gasoline, kerosine, No. 2 fuel, and residual as published in The Oil and Gas Journal.

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FOR SALE EQUIPMENT

FOR SALE: ENGINE—165 Hp. Climax Model R6I, maximum continuous Hp. rating 126. Herndon Drilling Company, 421 Mayo Building, Tulsa, Phone 4-9700.

FOR SALE: 12,000' 4" o.d. seamless line pipe. 40' random lengths. Clean inside and out. Beveled ready to lay 35c f.o.b. our yard. M. J. Regan Pipe Co., Coffeyville, Kans.

PIPE. New seamless J55 mill end 5½" and 7" from Pueblo mill. Get our low prices. Pressey & Son, Pueblo, Colorado.

SALES and rentals of cable drilling and fishing tools, casing and equipment, from the Southwest's largest stock of used cable tools and oil field supplies. Degen Pipe and Supply Co., Tulsa, Oklahoma.

Gaso Duplex 4½" x 6" Power Pumps with Chrysler C-36 Engines, skid mounted, immediate delivery. Also Byron Jackson, Carter Centrifugal Units. Westinghouse 20-25-50 KW Generating Units.

H. H. COFFIELD
Attn.: W. H. ORR
Phones: 132—Rockdale, Texas
AT-3427—Houston, Texas

1—250 Bethlehem Draw Works in excellent condition, equipped with Tex-Rope Compound and 2—JL 1335 Buda Engines.
1—350 Bethlehem Draw Works in excellent condition, equipped with Unit Compound and 2—NK "Waukesha" Engines.
5000 Feet—Used 4½" Drill Pipe.
1—G-6 National Swivel.

To see contact F. A. Cowsar or Leonard Burt, Phone #40, Davenport, Oklahoma.

FOR SALE IN OHIO

I-R Gas Engine Driven Angle Type Gas Compressors Model 62 KVG-2 600 H.P. 350 RPM. Low pressure cylinder 30" X 14" high pressure cylinder 14½"-X 14" discharge pressure of second stage 155 psig.

ALSO

1000 K.W. G.E. Condensing Turbine—generator set with direct connected exciter and surface air cooler.

THE STANDARD OIL CO.
1401 Midland Blvd.
Cleveland 15, Ohio
R. L. CHARLES OR W. J. PENCE

FOR SALE EQUIPMENT

MODEL H CARDWELL Servicing Unit. Truck mounted with mast. Fully equipped. Box No. 1 or Phone 153, Canton, Kansas.

FOR SALE: Cardwell "RL" Double Drum Unit, recently overhauled, complete tools for 5" and 7" casing. Now working north of Ardmore—67' derrick, 6000' lines, tool house, light plant. Sale Price $18,000. Box H-183, The Oil and Gas Journal, Tulsa, Oklahoma.

1—1250 KVA Turbo-Generator, 1—730 KVA Turbo-Generator; both Steam Turbines 150 P.S.I.; Condenser for both Generators; 2 Air Ejectors; Oil Filter for both units and pump. This material was used to furnish power for city of 50,000 people. Can be inspected in Houston. For particulars, wire, write or call Bogle Pipe & Steel Company, 102 Heights Blvd., VIctor 6333, Houston.

FOR SALE: New Emsco G-42 Draw works complete with Caterpillar diesel engines, Gardner pumps; with or without 129' Emsco mast or 96' Ideco or drill pipe and drill collars. Priced at less than 50c on the dollar. Phone, wire or write Dunlap & Graham, Inc., 2450 Cerritos Avenue, Long Beach, California.

COMPLETE ROTARY RIG, Unit 34 Hoist, 94' Lee C. Moore Mast, 4' Substructure, 7¼ X 12 Pump, Shale Shaker, 4000' of 4½" extra good Drill Pipe, all necessary hand tools, Subs, 5", 7" and 10¾" Casing Tools. Write or call for inventory, Seran Drilling Company, Phone 450 or 657, Okemah, Oklahoma.

U. S. ENAMELING CO.
Brackets **SIGNS** Standards
for the entire industry
Lease-Well, Sales Promotion, Safety
Quality———Economy
Tulsa—Box 4116
Sand Springs—Box 448

FOR SALE
12 NEW STERLING ENGINES
VIKING NO. II
8 cylinder, 600 hp., 1200 r.p.m.
Will sell crated for export F.O.B. dock, San Francisco.

S. & W. Machinery & Supply Company
Pier 3
San Francisco, California
YUkon 6-6853

FOR SALE EQUIPMENT

FOR SALE: Late model Beechcraft Bonanza with under 250 hours. Fully equipped with complete instrument and radio gear, and many extras. Reasonably priced. Box H-179, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE: At Madison, Kansas, 4—50 hp. and 1—60 hp. Superior, 4 cycle, commercial type horizontal, single cylinder, gas engines. Price $500.00 each. Also, 20' and 24' double eccentric steel bandwheel powers. $250.00 and $350.00 each. Cities Service Oil, Patridge, Bartlesville, Oklahoma.

FOR SALE: One 18-trace set of reflection seismograph instruments, rack and panel mounted. Very reasonably priced. Texas Seismograph Company, Box 2069, Phone 3-1493, Wichita Falls, Texas.

FOR SALE—At our Arkansas City, Kansas, gasoline plant, 11—10' x 40' horiz. gasoline storage tanks, $850.00 each. Cities Service Oil Company, Patridge, Bartlesville, Oklahoma.

Model 21 Combination Reflection-Refraction Seismograph

GS-13 4 Cycle Refraction Geophones
GS-15 20 Cycle Reflection Geophones
100 Cycle Timing Motors

ENGINEERING PRODUCTS INC.

600 E. 4th St. Phone 2-7223
Tulsa 3, Oklahoma

PIPE

8⅝" O.D. .322 wall 28,000 ft.
12¾" O.D. .375 wall 26,000 ft.
Reconditioned Line Pipe
18 foot R. L.

NEW ELECTRIC WELD REJECTS

7" O.D.	.317 wall	200 feet
8⅝" O.D.	.352 wall	500 feet
9⅝" O.D.	.395 wall	3,000 feet
16" O.D.	.375 wall	1,460 feet
20" O.D.	.281 wall	1,300 feet
24" O.D.	.281 wall	720 feet
24" O.D.	.406 wall	920 feet
26" O.D.	.281 wall	1,100 feet
26" O.D.	.312 wall	820 feet
26" O.D.	.500 wall	120 feet

All 40 foot lengths
Special Low Price
Write—Wire—Phone

SONKEN - GALAMBA CORPORATION

2nd and Riverview (X-148)
Kansas City 18, Kansas
ATwater 9305

FOR SALE EQUIPMENT

100,000 FEET Good Used 8" line pipe .322 wall, 28.55# lapweld, 8⅝ O.D. 1500 foot lots, F.O.B. location Illinois & Indiana. Peter Grimm, 119 Washington Avenue, Stamford, Conn.

NEW 12¾ SEAMLESS COUPLINGS $4.75 each. Edco Pipe & Supply. Box 151, Tulsa, or phone 4-5070.

DEPTH AND TEMPERATURE machine. Built by government. Very good condition. Harry J. Abrams, 331 Emerson N.W., Washington 11, D. C.

250,000 FT. 8⅝ o.d. pipe with collar and plain end. $1.00 per foot Oklahoma. Rogers & Lundquist, 630 Wright Building, Tulsa, Okla. Phone 3-2073—3-3850.

14 VARICYCLE PUMPING UNITS capable of pumping to depth of 5000'. $800.00 each. Dr. Sam G. Dunn, 1312 Main St., Lubbock, Texas.

SUPER ELECTRONIC Magnetometers, Scintillometers, Geiger Counters, Radioactive ores. Geoelectronic Scope Co., Route 11, Box 449, Fort Worth, Texas.

ROPER PUMP UNITS, (5) with 3 hp.—3 ph. 220/440 West. motor. Exc. cond. Harry J. Abrams, 331 Emerson St. N.W., Washington, D. C.

FOR SALE: At our Oklahoma City warehouse, a quantity of 9" OD 40# used J-55 seamless steel casing, 8V thd. ST&C, unshopped $2.50 per ft., shopped $3.00 per ft. Also 9" OD 46.10# LT&C ditto shopped $3.60 per ft. Cities Service Oil Company, Patridge, Bartlesville, Oklahoma.

DRILLING equipment. New and used spudders, rotaries, tools. Everything for well drilling. Fishing tools rented. Pressey & Son, Pueblo, Colorado.

THREE #12 Sweetland Filters, 48 bronze leaves, monel covered, on 3" C.C.; 2 unused, 1 slightly used. 11—Sperry 18" x 18" cast iron Filter Presses, 11 chambers. Consolidated Products Co., Inc., #65 Garden Street, Hoboken, N. J. N.Y. Tel.: BArclay 7-0600.

FOR SALE: Model "K" Cardwell single drum well servicing unit, powered by 6-SRK Waukesha. With single pole telescoping mast, tubing line, 2", 2⅛" and 3" tubing tools mounted on Ford tandem truck; ½ ton Studebaker service pickup. Good running condition. For details, call or write Melco Drilling Company, Phone 2333, Box 1360, Seminole, Oklahoma.

WANT EQUIPMENT: Did you find the equipment you wish to purchase in this column? If not, use an "Equipment Wanted" classified advertisement to find it. It is available somewhere and Journal classified advertisements will find it. See box heading for classified rates, or write The Oil and Gas Journal.

FOR SALE

5—Cooper Type 80 Twin. Comp. Cyl. to suit.

2—Superior 100 H.P. 11x5½ Comp. Cyl.

1—Bessemer Type X Single.

Compressor Cylinders, Coopers, Clarks, and Bessemer various sizes and W.P. 20" stroke.

Clark 14" Stroke—20"-26-21-4½" 3¾" Bessemer—Clark—Cooper Bed Plates Flywheels—Shafts—Crossheads and Parts

W. S. SMITH
205 Thompson Bldg., Tulsa, 2-5473.

FAILING TRUCK MOUNTED CORE DRILL FOR SALE

1—Failing model 750 drill unit purchased new 1952. Includes:

Drill head with complete hydraulic system. 26' mast—30,000# Cap. Complete with 200 feet 2⅜" drill pipe and all accessories and operating equipment. Mounted on International L-162 truck, 130" wheelbase, 2-speed rear axle. Only slightly used. Price $12,500, F.O.B. Macon, Georgia.

For complete description write
J. R. Slocum, c/o
THE DIVERSEY CORPORATION
685—12th St. Phone 2-4027,
Macon, Georgia

EQUIPMENT WANTED

WILL PAY highest prices for used casing, used line pipe, abandoned leases, or other surplus lease equipment. Your idle producing equipment is worth dollars. Green Pipe & Supply Co., Box 1383, Tulsa, Oklahoma.

USED PULLING Machines, double drum and capable of servicing to 5500. Box 928, Midland, Texas.

EQUIPMENT NOT IN USE: Did you find a buyer in this column for the equipment you have for sale. Someone wants it and an "Equipment For Sale" classified advertisement in the Journal will find a buyer. See box heading for classified rates or write The Oil and Gas Journal.

MATERIAL WANTED

One 13⅝" Shaffer Blowout Preventer, Type 39. One 10¾" Shaffer Blowout Preventer, Type 39.

MAKIN DRILLING COMPANY
P.O. Box 1628
Hobbs, New Mexico

HELP WANTED

WATER FLOOD ENGINEER

With necessary experience to take charge of entire development and operation of three major floods and several minor floods in close proximity of each other. Must be thoroughly experienced and capable of daily supervision in field. Give education, experience, reference and or reply for more details. Interview will be granted if above requirements can be met. Address J. C. Miller, Box 247, Owensboro, Kentucky.

PETROLEUM OR RESERVOIR ENGINEER

With minimum 3 years experience in development, production and oil and gas reservoir engineering on primary and secondary recovery problems. For New York office of major foreign producer.

MICROPALEONTOLOGIST

Preferably with an advanced degree and a minimum of 5 years' commercial or academic experience. To work in New York research laboratory. This position demands broad interests in Stratigraphy and Biofacies and the capacity to do independent work on projects assigned.

Salary for above positions dependent on experience and qualifications. Write giving full particulars regarding personal history and work experience. Please include telephone number.

RECRUITING SUPERVISOR

BOX OGJ-11

Arabian American Oil Company

505 Park Avenue

New York 22, N. Y.

HELP WANTED

FOREIGN EMPLOYMENT. List of oil companies and drilling contractors showing where to apply for foreign jobs. OIML Co., Box 2003, Tulsa, Okla. $5.00 cash.

RESEARCH CHEMIST
Challenging opportunity for a man with several years' industrial research experience on catalysts for petrochemicals. Require M.S. and/or Ph.D. degree. Send complete resume including expected salary. Address replies: Personnel Director, The Harshaw Chemical Co., Cleveland 6, Ohio.

FIELD SUPERINTENDENT: Independent Producing Company needs mature man with considerable primary and secondary-recovery experience to manage large project in Mid-Continent area. Must have good knowledge of production, drilling and rework, and supervision of large field organization. State age, experience record, salary expected, and full details in first letter. Replies strictly confidential. Box H-157, The Oil and Gas Journal, Tulsa, Oklahoma.

OIL INDUSTRY Employment Service, Tom Robinson, owner, 405 Tuloma Bldg., Tulsa, Oklahoma. For technical and trained oil industry personnel. Write for blank.

THE SUPERIOR OIL COMPANY has an opening in the Geophysical Department, starting as a computer. College degree in Geology, Geological or Petroleum Engineering required plus math through calculus and basic physics. No experience required. Send transcript, photo and letter of application to Personnel Department, The Superior Oil Company, Midland, Texas.

ENGINEER with experience in field of corrosion to set up and maintain corrosion control program on Gulf Coast off-shore installations for major oil company. Location in Mid-Continent Region. Salary commensurate with experience. Please summarize educational and experience background in first letter. Box H-185, The Oil and Gas Journal, Tulsa, Oklahoma.

THE POSITION YOU WANT: Oil industry companies are looking for men to fill every conceivable kind of position. If you didn't find the position in this column that you are looking for, use a "Situation Wanted" classified advertisement to state your qualifications. Some company is probably looking for your ability. See box heading for classified rates or write The Oil and Gas Journal.

SUPERVISOR OF CATALYTIC CRACKING AND ALLIED OPERATIONS

Modern Mid-Continent refinery seeks man to supervise fluid catalytic cracking and allied operations. Must have fluid cracking and general refinery experience. College degree or equivalent. In reply please state qualifications. All replies confidential. Our employees know of this ad.

Box H-154, The Oil and Gas Journal, Tulsa, Oklahoma

SITUATIONS WANTED

ATTENTION: Well established oil well drilling contractor desires to manage and supervise: Individuals', groups', small or medium-sized oil companies' drilling, production and operating problems in Central and Western Texas and New Mexico. Personal interview by appointment is desired. Makin Drilling Company, Box No. 1628, Ph. No. 3-3141, Hobbs, New Mexico.

SALES—Want to represent manufacturer of products and equipment used by the oil refining industry in states of Michigan and Ohio—many good contacts and years of experience this field. Box H-184, The Oil and Gas Journal, Tulsa, Oklahoma.

DIESEL ENGINE maintenance Superintendent: 14 years experience with GM, Cummin, Caterpillar Superior, Budas. Rig Experience Also. 7 years supervisory experience. Pilot and A & E mechanic license. Experience in South America, speak Spanish. Age 32, married, two children. Foreign service will be considered. Box H-182, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER: 26. M.S. degree, 1 year field and 2½ years Gulf Coast Multi-Zone reservoir experience. Schlumberger electric log school. Reserves, exploitation, pressure-maintenance and water-drive studies. Desires Houston, Dallas, or Tulsa location. Resume on request, presently employed. Box H-189, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

ARE YOU LOOKING FOR THIS MAN? Geological Engineer seven years thorough experience Petroleum Geology. Capable and well qualified. Seeks position with company operating in Mid-Continent or Rocky Mountain area. Box H-163, The Oil and Gas Journal, Tulsa, Oklahoma.

REFINERY SUPERINTENDENT or opportunity in refining organizations: Middle aged—Over 25 years experience in design, construction, modification, operation and maintenance of several complete refineries. Including solvent processing of Lubes and Waxes. Thoroughly experienced in organization and personnel development and manipulation. Especially qualified in analysis of operation and manipulating for maximum yields and realizations; at same time maintaining satisfactory product controls and production planning with marketing organization. Will consider subordinate position with opportunity . . . domestic or foreign location, or opportunity with consulting organization. Box H-181, The Oil and Gas Journal, Tulsa, Oklahoma.

PRODUCTION SUPERINTENDENT: Graduate Engineer, Age 31, married, 7 years experience. Desire association with independent in Kansas. Am presently employed as production superintendent with independent in Oklahoma. Have had 6 years experience in Kansas production. Box H-180, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST, 32, Sc.D., P.Eng., with surface and subsurface experience in Canada, Europe, and Middle East (mining and oil), desires challenging position in Latin America; research preferred. Box H-190, The Oil and Gas Journal, Tulsa, Oklahoma.

PROFESSIONAL Engineer, over 20 years experience in all phases of the oil and gas business. Desires a change if the right connection can be made. Box H-192, The Oil and Gas Journal, Tulsa, Oklahoma.

EXPERIENCED production superintendent desires permanent employment, can also handle well completion, fracturing and hookups. Good education and knows materials. Dependable, reliable and no bad habits. References. Reply, Box H-191, The Oil and Gas Journal, Tulsa, Oklahoma.

B.S. IN CH. ENG. 1943, age 32, married, experience, 4 years in control laboratory, 7 years long range programing and economics of refinery operations, all with major oil companies in Latin America. Desire return to U. S. Box H-193, The Oil and Gas Journal, Tulsa, Oklahoma.

THE RIGHT MAN: Can you fill the position you have open from the qualifications listed in this column. Men are always looking for an opportunity to improve themselves. Use a "Help Wanted" Journal classified advertisement to find the men you need. See box heading for classified rates or write The Oil and Gas Journal.

CAPITAL WANTED

NEED CAPITAL for developing Oklahoma leases. Major company will provide detailed geophysical data on areas involved. Reply: Box H-177, The Oil and Gas Journal, Tulsa, Oklahoma.

ROYALTIES

GET TOGETHER: Both Capital and Royalties are available. If the investment proposition you want isn't listed in this column, use a Journal classified advertisement to find it. See box heading for classified rates, or write The Oil and Gas Journal.

LEASE AND DRILLING BLOCKS

80,000 ACRES: Mineral timber land, Tennessee—$3.50 per acre, all mineral rights. Details—E. Jester, 12744 Vanowen, North Hollywood, California.

SALE OR FARMOUT—All or part 18,000 acres Fremont Co., Wyo. Production three sides. 1068 acres Weston Co., Wyo. Close to production. L. K. Strauss, Temple, R. D. 1, Pa. Phone Reading 9-4673.

FOR SALE: Colorado lease and mineral rights. Small or large acreage. See or write E. H. Grantham, Ordway, Colo. Phone 9921 or 2327.

WILL pay cash instantly for lease (large blocks), royalties, mineral deeds, production. Write fully—P. O. Box 2153, Denver, Colorado.

SEE A. L. BOWLES, Box 947, Ada, Okla., for attractive drilling deals and producing royalties.

WANTED—Lease blocks anywhere. Submit description, geology and terms. Box H-188, The Oil and Gas Journal, Tulsa, Oklahoma.

2100 ACRES, 4 miles South East Forest discovery in 7 S. R. 31 E. Chavez County, New Mexico. Drilling proposition wanted. Box 785, Station H, Los Angeles, California.

WE HAVE drilling block of approximately 3,000 acres with all available geology including contour map, Western Arkansas. For particulars contact Burl H. Little, 302 North Highland. Phone 1133-W, Sherman, Texas.

LOOKING FOR A LEASE? There will be over 40,000 wells drilled this year. If you are looking for a lease, drilling block, or drilling deal and haven't found it in this column, or if you have a lease or drilling block you want drilled, a Journal classified advertisement can find an interested party. See box heading for classified rates, or write The Oil and Gas Journal.

OIL & GAS STRUCTURES
SE New Mexico well to drill next to S.I.W. Showed for prod. 2 zones Permian. Interests available. SW Wwo.: well to drill major structure west of large prod. Frontier & Sundance sds. Data both areas on request.

W. J. PETERMAN, Geologist
1918-1954
Portales — New Mexico

LEASES ROYALTIES
Producing and Nonproducing
Bought and Sold—Any Area
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6633 Delmar Ave., St. Louis 5, Mo.

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Drumright, Oklahoma
Work in Any Field in the World

BUSINESS SERVICE

Delaware Corporations formed and serviced, American Guaranty & Trust Company, P.O. Box 487, Wilmington, Delaware.

RANCHES

RANCH on White River. 1300 acres. Carroll County, Arkansas. Good hay meadows and pastures. Modern owner's lodge with two fireplaces. Modern foreman's house. Good modern barns, corrals. Fenced and cross-fenced. Nine improved permanent springs. Price $40,000.00. For details write C. C. King, Eureka Springs, Arkansas.

SERVICES

QUICK SERVICE PIPE DRILLER
Specialize in drilling out any size tubing, drill or line pipe plugged with cement, sand corrosion or paraffin. Drill and clean any size underground salt water lines. Operate in Texas and adjoining states. Call collect day or night: ME-2338. W. H. Anderson—1010 E. Cross Timbers, Houston 22, Texas.

BUSINESS OPPORTUNITIES

PARTNER WANTED: I wish to form an association with some reliable individual Oil Drilling Contractor, Operator, Geologist or Petroleum Engineer, who already has or can get good drilling deals. At this time I am in position to raise Capital for drilling several wells. Exchange of references essential. Box H-186, The Oil and Gas Journal, Tulsa, Oklahoma.

REAL ESTATE

SPACE IS NEEDED: A Journal display classified advertisement is the quickest way to rent or sell your real estate. In the present period of expansion oil industry firms urgently need the space you have available. If it isn't listed here, you may also find it by stating your needs in these pages. For classified rates see box heading or write The Oil and Gas Journal.

BOOKS FOR SALE

DOODLEBUGGING — DOWSING — DIVINING — A scientific and unprejudiced analysis of the influence of electromagnetic fields on psychic phenomena, with particular attention to divining (doodlebugging). PSYCHICAL PHYSICS by S. W. Tromp, Professor of Geology, Louad 1 University, Cairo (Egypt), is a 534 page volume (153 illust.) in which the author analyzes all existing knowledge of divining phenomena. Oil operators will find this book thought provoking. Only limited copies left. Write now for yours. Price $8.00. ELSEVIER PRESS, 402 Lovett Boulevard, Houston 6, Texas.

OPPORTUNITIES CAPITAL

OPPORTUNITY FOR CAPITAL

Reliable firm of Registered Professional Petroleum Engineers, with long and varied technical and practical experience in drilling, oil and gas property management and development, and secondary recovery operations, desires contact with substantial sources of capital interested in oil and gas prospects and properties.

Not interested in promotional ventures, but willing to exchange references and discuss terms with desirable and suitable clients.

Box H-187, The Oil and Gas Journal, Tulsa, Oklahoma

OPPORTUNITIES CAPITAL

? ? THE BIG QUESTION ? ?

Is there any spot in this country that is ideal for farming?

The U. S. Weather Bureau Climate reports indicate there is no place that can touch Grants Pass, Oregon.

Factors making for Pleasant Living:
Lowest wind velocity in the U. S. A.

Mountainous appearance yet only 900 feet above sea level.

Fine Hunting and Fishing.
No Defense Industries.

Approx. 2½ hours flying time to Portland, 2 hr. 45 min. to San Francisco. Analyze these facts then compare this fine Southern Oregon Stock Ranch: 776 Acres, 150 irrigated. Old water right. Many acres open meadow. Low plateau to general sloping tree-covered hillside terrain. New three-bedroom contemporary home blends with the natural beauty of its surroundings. 650-ton modern barn, work shop, storage sheds, plus two sets of farm buildings. Full line of farm machinery.

Where can you find all of the above for less than Two Hundred Thousand Dollars?

VALLEY FINANCE CO.
P.O. Box 135
Grants Pass, Oregon

WRITE FOR FREE BROCHURE

WILDCAT COMPLETIONS

(Continued from page 230)

SE 19-16n-15w. Dry. TD 2,158 ft. in Traverse lime.

St. Clair County: The Dow Chemical Co. 1 Hoskins, SW NE SW 11-6n-15e. Dry. TD 3,560 ft. in Niagara.

Van Buren County: Norman L. Stevens 1 Gustin, NE SE SE 15-1s-15w. Dry. TD 1,217 ft. in Traverse lime.

ALABAMA

Monroe County: Lyle Cashion Co. et al 1 Belcher, C NW SE 19-5n-6e. Dry. TD 5,274 ft. Elev. 204 ft., lower Tuscaloosa 5,082 ft.

MISSISSIPPI

Jefferson County: Humble Oil & Refining Co. 1 Shields, 22-8n-2w. Dry. TD 5,993 ft. Elev. 242 ft., Wilcox 3,867 ft., base Big shale 5,204 ft., Artman zone 5,540 ft.

SOUTH LOUISIANA

Allen Parish: Sun Oil Co. 1 Houston, 26-6s-5w. IP 169 BOPD, 8/64-in., 29.4°, perforations 7,684-90 ft. TD 8,300 ft. (New pay in, and extends Kinder field).

Calcasieu Parish: M. H. Marr 1 Odom, 21-11s-13w. IP 173 BOPD, 8/64-in., 37.5°, perforations 9,780-92 ft. TD 11,550 ft. (New pay in Phoenix Lake field.)

Cameron Parish: John W. Mecon 1 Lea, 9-12s-12w. IP 479 BOPD, 12/64-in., 41°, Marginulina 7,950-66 ft. (perforations). TD 8,772 ft. (New pay in Black Bayou field).

Pointe Coupee Parish: The Texas Co. 5 Lottie, 26-6s-8e. IP 4,100 M.c.f. daily, open flow, perforations 9,105-11 ft. TD 10,265 ft. (New pay in Lottie field).

St. Bernard Parish: Phillips Petroleum Co. 2 State Lease 2221, Tract 5194, Eloi Bay. IP 483 BOPD. 12/64-in., 29°, perforations 5,875-77 ft. TD 7,110 ft. (New pay in Eloi Bay field).

St. Landry Parish: The Texas Co. 63 Botany Bay, 19-6s-6e. IP 175 BOPD and 2,373 M.c.f. daily, 14/64-in., 50.2°, perforations 10,995-11,016 ft. TD 12,150 ft. (New pay in, and extends Port Barre field).

West Baton Rouge Parish: Monterey Exploration Co. 1 Wilberts Sons, 14-7s-11e. Dry. TD 10,001 ft.

ARKANSAS

Calhoun County: Pan Am Southern Corp. 1 Freeman-Smith, C NE NE SE 30-15s-13w. Dry. TD 5,198 ft.

Hempstead County: Ed E. Hurley 1 Foster, C NE NW NE 16-14s-23w. Dry. TD 3,615 ft.

Lafayette County: Benedum-Trees Oil Co. 1 Caldwell & Lowe, 3-20s-26w. IPF 192 BOPD, 47°, ¾-in., Mitchell sand 6,006-14 and 6,020-30 ft. TD 6,912 ft. (Extends Kiblah pool and new pay.)

Union County: Lawton Oil Corp. D-1 Mayfield, C SW SE SE 16-18s-17w. IPF 160 BOPD, Pettit 4,004-16 ft., 43.5°, 12/64-in. TD 5,750 to ft. (New pay in Schuler field.)

Lion Oil Co. 1 Irby, 22-18s-17w. IPF at rate of 548 BOPD, Cotton Valley stray sand No. 6, 20/64-in. 5,764-69 ft. TD 5,855 ft. (New stray sand in Schuler field.)

OKLAHOMA

Atoka County: Russell Cobb, Jr. and Derby Oil Co. 1 Sullivan, NW NE SW 13-3s-9e. Dry. TD 3,675 ft.

Choctaw County: Hal Welch et al 1 Mosley, NE NE NE 11-7s-13e. Dry. TD 1,907 ft.

Cleveland County: The Ohio Oil Co. 1 Neal, NW SE NE 13-6n-1e. Dry. TD 6,735 ft.

MacMillan Petroleum Corp. 1 Woods, NW NW NW 3-7n-1e. Dry. TD 6,644 ft.

Comanche County: Zipp Oil Co. 1 Bain, NW NE NE 14-1s-14w. Dry. TD 400 ft.

Cotton County: The Ohio Oil Co. 1 Chapman, SE SW NE 3-4s-12w. Dry. TD 4,611 ft.

Grant County: Republics Natural Gas Corp. 1 Ward, SW SW SE 17-29n-3w. Dry. TD 4,863 ft.

Hughes County: Creslenn Oil Co. 1 Bond, SW NW SW 12-5n-8e. IPP 6 BOPD, Booch sand 2,364-72 ft., 30°. TD 4,925 ft. (Oil well).

Kay County: Smitherman 1 Boggs, NE NE NE 12-28n-2e. Dry. TD 3,463 ft.

C&G Drilling Co. 1 Holland, SW SW SE 15-28n-1w. Dry. TD 3,428 ft.

Lincoln County: Oklahoma Natural Gas Co. 1 Moore, NW NW SE 21-17n-2e. IPF 157 BOPD, Cleveland 3,608-22 ft., 3,229 M.c.f. per day, 43°, 24/64-in. TD 4,925 ft. (Oil discovery).

Logan County: O'Rourke, Wilcox & Henry 1 Brooks, NE NE SW 21-16n-1e. Dry. TD 5,525 ft.

Okmulgee County: W. L. Kincaid 1 Wilson, C S½ SW SW 4-14n-13e. Dry. TD 1,400 ft.

Pontotoc County: R. B. Suttle 1 Hisaw, SW NW NE 8-2n-7e. Dry. TD 2,373 ft.

Stephens County: Rex Leath 1 Green, NW NW NW 3-2s-9w. Dry. TD 2,733 ft.

Hefner Production et al 1 Morrison, SE SW SE 20-2n-5w. Dry. TD 3,135 ft.

Washington County: Mac Drilling Co. 1 Little, SW SE SE 7-23n-13e. Dry. TD 1,453 ft. Geological wildcat.

KANSAS

Barber County: Granehart & Miller et al 1 Lenker, SW NE SW 24-33s-14w. IP 8,000 M.c.f. of gas per day, Miss. 4,813-27 ft. TD 5,355 ft. (Gas discovery).

Cowley County: Mid-Continent Petroleum Corp. of Olsen, SE SE NW 13-35s-6e. Dry. TD 3,018 ft.

Graham County: National Cooperative 1 Bangle, NW NW SW 5-6s-25w. Dry. TD 4,034 ft.

Marion County: Adair Oil Co. 1 Hale, NE NE NE 33-21s-3e. Dry. TD 2,955 ft.

Gaty et al 1 Hansen, C S½ SE NW 3-20s-4e. Dry. TD 2,580 ft.

Mitchell County: Murfin Drilling Co. et al 1 Stillwell, SW SW NW 12-6s-6w. Dry. TD 4,000 ft.

Pratt County: Natural Gas & Oil Corp. 1 Webb, SE NW NW 18-26s-12w. Dry. TD 4,462 ft.

Lario Oil & Gas Co. 1 Eubank Est. "A," NE SE NW 30-28s-14w. Dry. TD 4,800 ft.

Reno County: Stearns Petroleum Co. 1 Bergkamp, SE SE SE 33-26s-5w. Dry. TD 4,270 ft.

Rupp Ferguson Oil Co. 1 Rogers, NE NE NW 25-25s-6w. Dry. TD 4,035 ft.

Rooks County: Jones, Shelburne & Farmer 1 Baldwin, NE NE NE 11-9s-20w. Dry. TD 3,716 ft.

Sedgwick County: J. P. Gaty 1 Bierman, NW SW NW 10-28s-2e. Dry. TD 3,330 ft.

Champlin Refining Co. 1 Goering, NE NE SE 3-25s-1e. Dry. TD 3,650 ft.

Wabaunsee County: Musgrove Petroleum et al 1 Langley, NE NE NE 13-13s-10e. Dry. TD 3,335 ft.

NEBRASKA

Kimball County: Tuley & Carter 1 McGowan, NE NE NE 32-14n-54w. Dry. TD 6,135 ft.

Morrill County: Tuley & Carter 1 State, NW NE NE 16-20n-51w. Dry. TD 4,165 ft.

EASTERN NEBRASKA

Saunders County: W&M Oil Co. 1 Nelson, C NE NE 35-16n-8e. Dry. TD 1,743 ft.

NORTH DAKOTA

Bottineau County: Cardinal Drilling Co.-Deep Rock Oil Corp. 1 John Fraser, SW NW 13-163n-80w. Dry. TD 4,101 ft. in Lodgepole.

Dakota Drilling Co. 1 Ole Anderson, C SE NW 19-161n-81w. Dry. TD 6,604 ft. in Interlake.

Rolette County: S. D. Johnson 1 Lawson, NW SW 16-163n-69w. Dry. TD 2,681 ft. in Jefferson.

CALIFORNIA

Alameda County: The Texas Co. 1 Maud Stanley, 20-2s-2e. Dry. TD 10,032 ft.

Colusa County: R. S. Rheem, Oper. 1 Zumwalt, 26-18n-2w. Dry. TD 3,500 ft.

Glenn County: General Petroleum Corp. 1 Kimjones, NW 14-19n-2w, IPF 3,500 M.c.f. daily, 21/64-in. choke, perfs. 5,324-38 ft., TD 6,000 ft. (West extension and new pool discovery in Beehive Bend field.)

Kern County: Ferguson & Bosworth 1 Jameson, 20-29s-28e. Dry. TD 1,517 ft.

General Petroleum Corp. 15-24 Guimarra, 24-30s-28e. Dry. TD 10,509 ft.

G. Graham 5 Graham, 23-25s-18e. Dry. TD 1,064 ft.

Honolulu Oil Corp. 5 Watson-C.W.O.D. Fee, 23-30s-21e. Dry. TD 5,903 ft.

Li-Jo Oil Co. 32-1 Well, 32-9n-17w. Dry. Bottomed in granite, TD 1,554 ft.

Shell Oil Co. 14-24 P.M.L., SW NW 24-30s-21e, IPF 16 BOPD, 10/64-in. choke, 240 M.c.f. gas, perfs. 7,098-7,142 ft., TD 7,592 ft., PB 7,181 ft. (Approx. ½ mile extension to Belgian Anticline field.)

Los Angeles County: Fowler & Oles Oil Co. 1 Robinette, 26-5n-16w. Dry. TD 2,423 ft.

Madera County: H. H. Magee, Oper. 2-1 Stone, 1-12s-14e. Dry. TD 4,020 ft.

Gene Reid Drilling Co., Inc. 26-A 21, 21-12s-15e. Dry. TD 4,155 ft.

San Benito County: Oceanic Oil Co. 1 Chambers, 11-18s-9e. Dry. TD 5,676 ft.

Santa Barbara County: C. W. Colgrove 11-A Russell, 24-10n-27w. Dry. TD 5,530 ft.

Sutter County: Humble Oil & Refining Co. 1 Sutter Basin Corp., 24-13n-2e. Dry. TD 7,307 ft.

MONTANA

Fergus County, Button dome: United Petroleum and Mining Co. 1 Woodworth, C SE NW 20-14n-24e. Dry. TD 3,963 ft. in Cambrian.

WYOMING

Carbon County: Carter Oil Co. 1 Unit, C SE NE 17-13n-89w. IP 874 M.c.f. of gas per day, Mesaverde discovery, new field. TD 8,055 ft.

Washakie County: Brinkerhoff & Vaughey & Vaughey 1 Government, SE SW SE 15-48n-90w. Dry. TD 2,320 ft. in Tensleep.

COLORADO

La Plata County: Holgate & Barr 1 Barr, SW NE NW 23-33n-12w. Temp. abd. TD 714 ft.

Morgan County: British-American 1 Livingston, NE NE NE 26-3n-56w. Dry. TD 5,275 ft.

Denver Basin Oil Co. 1 Rigsby, NE NE SE 26-6n-59w. Dry. TD 6,690 ft.

Frontier Refining Co. and Goodell 1 Ewertz, C NW NE 3-1n-60w. Dry. TD 6,467 ft.

Harper-Turner and Dunn & Boreing 1 Porter, NW NW SE 15-2n-57w. Dry. TD 5,717 ft.

Trans-Tex Drilling Co. 1 August, C SE SW 13-2n-56w. Dry. TD 5,114 ft.

Weld County: Wm. R. Whitaker Co., Ltd., and Don Rounds 1 UPRR, NW NW SE 33-1n-62w. Dry. TD 8,361 ft. in Lyons.

ARIZONA

Apache County: Shell Oil Co. 1 Navajo, C SE SE 6-41n-29e. East Boundary Butte area. Dry. TD 6,490 ft. Devonian 6,155 ft.

MANITOBA

Baum & Feil 7-11 Bonnie Doon, LSD 7, 11-4-5w1. Dry. TD 1,231 ft.

Hallis 12-25 Virden, LSD 12, 25-10-27w1. Dry. TD 2,257 ft.

British American-Canadian Superior 1 Woodnorth, LSD 3, 33-8-27w1. Miss. oil discovery. TD 2,870 ft.

SASKATCHEWAN

Canadian Gulf-Canadian-Devonian 9 Quinn, LSD 9, 34-3-4w2. Mission Canyon oil discovery. TD 4,655 ft.

Socony-Sohio 10-11 Readlyn, LSD 11, 10-8-28w2. Dry. TD 4,750 ft.

Phillips-Husky 1 Sandgren, LSD 7, 29-27-22w3. Dry. TD 3,067 ft.

ALBERTA

Ranchmen's 6-27, LSD 6, 27-35-9w4. Viking oil well. TD 2,997 ft.

Two New Members of Board Named by Arthur G. McKee

Two vice presidents of Arthur G. McKee & Co., have been elected to the board of directors, replacing two members who have retired from the company.

Merrill Cox, vice president in the metals division, and Myran J. Livingston, vice president in charge of petroleum division, became board members at the annual meeting of the stockholders, H. E. Widdell, president, has announced. They will replace William A. Haven and J. Krumhansl.

Livingston joined McKee in 1944 as head of the New York office. Soon after coming to Cleveland, he became sales manager of the company's petroleum division in 1949, assistant to the president in 1952, and was elected vice president in 1953.

Cox spent 4 years with Illinois Steel Co. before joining McKee in 1930. He rose to the position of sales manager of the iron and steel division in 1949, general sales manager of the company's metals division in 1952, and was elected a vice president of this division in 1953.

McEnroe Elected Treasurer For Halliburton

Election of G. D. McEnroe as treasurer of Halliburton Oil Well Cementing Co. has been announced by President L. B. Meaders. The new treasurer fills the vacancy created by the death of Hugh H. Leonard.

McEnroe joined Halliburton in 1940 as a tax accountant at Halliburton's Duncan, Okla., headquarters. He then filled the posts of chief tax accountant and assistant treasurer.

As treasurer McEnroe will be in charge of taxes, credit, traffic, and treasury departments for Halliburton.

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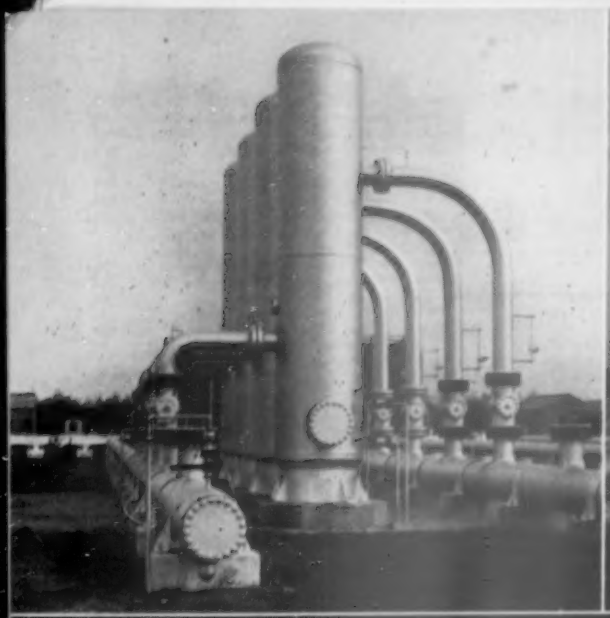
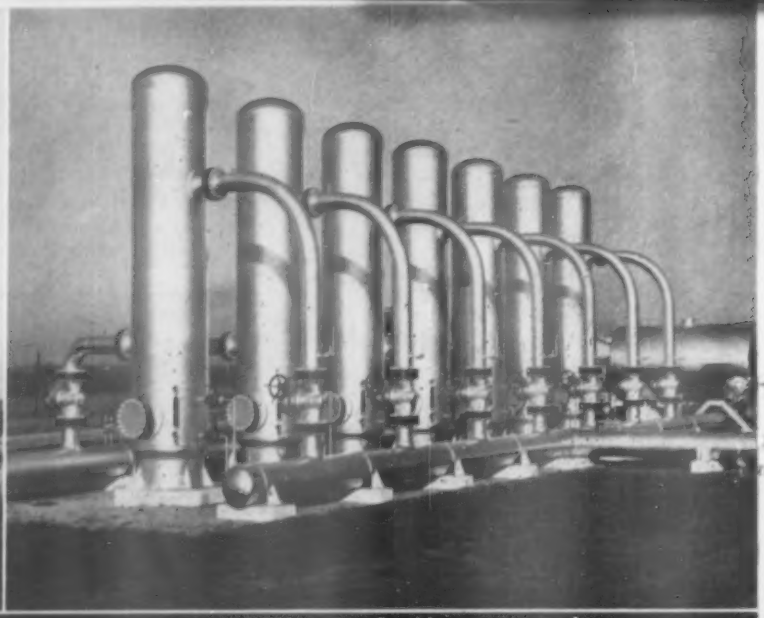
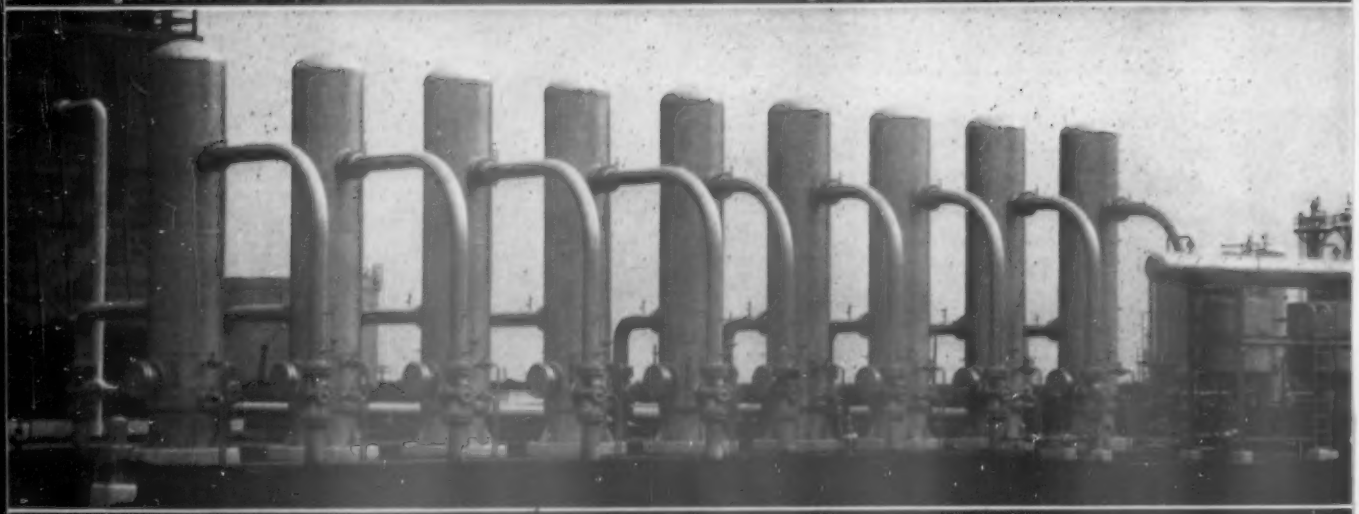
Wood's Sons Co., T. B. 181
Youngstown Sheet and Tube Company Inside Back Cover



NATIONAL Gas Scrubbers, main line gas booster station, Batesville Miss.



NATIONAL Gas Scrubbers, main line gas booster station, Monroe, La.



NATIONAL Gas Scrubbers, main line gas booster station, Banquitte, Texas

NATIONAL WET-TYPE SCRUBBERS

54" O.D. x 20' — 750 PSI MAX. WP.
90 MM CU. FT./DAY. 12" INLETS AND OUTLETS

The service required of Wet-Type Scrubbers! Pipe line dust and other foreign materials are removed ahead of compressors at each pressure boosting station. This is done best by passing the gas through a special oil bath in a National Wet-Type Scrubber, then removing the liquid particles from the gas stream when passing through the National Gas Scrubbing element in the top part of the Scrubber.

National Vertical and Horizontal Gas Scrubbers are available in a wide range of sizes, working pressures and capacities to fit the needs of gas producers and carriers.

It's a National®

NATIONAL TANK COMPANY

TULSA, OKLAHOMA

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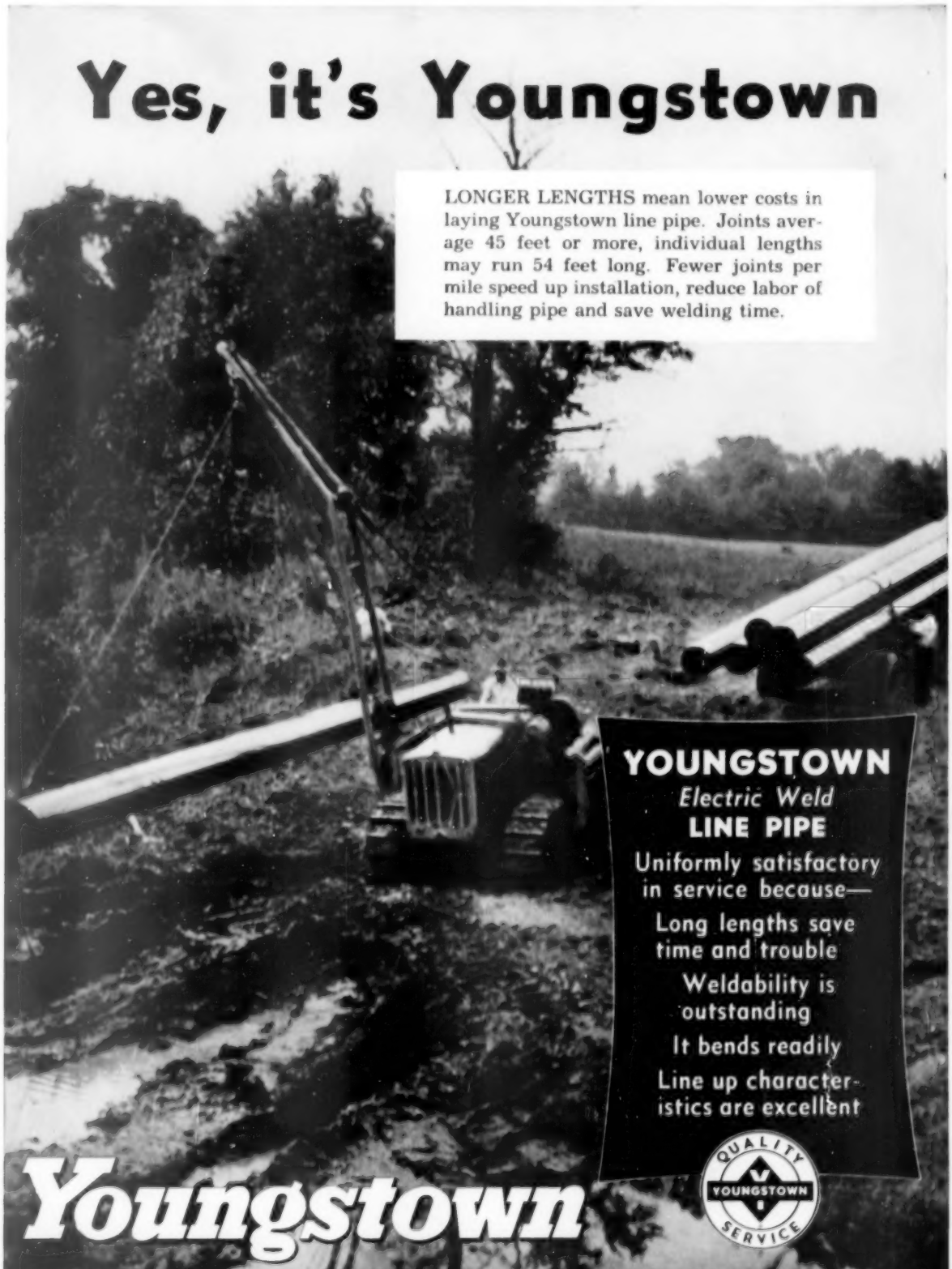

LONGER LENGTHS mean lower costs in laying Youngstown line pipe. Joints average 45 feet or more, individual lengths may run 54 feet long. Fewer joints per mile speed up installation, reduce labor of handling pipe and save welding time.

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Electric Weld
LINE PIPE

Uniformly satisfactory in service because—

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Weldability is outstanding

It bends readily

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Flash Welded
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so desirable for *UNITIZED* drill stems!

- Threaded prior to heat treatment, assuring maximum strength and durability.
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